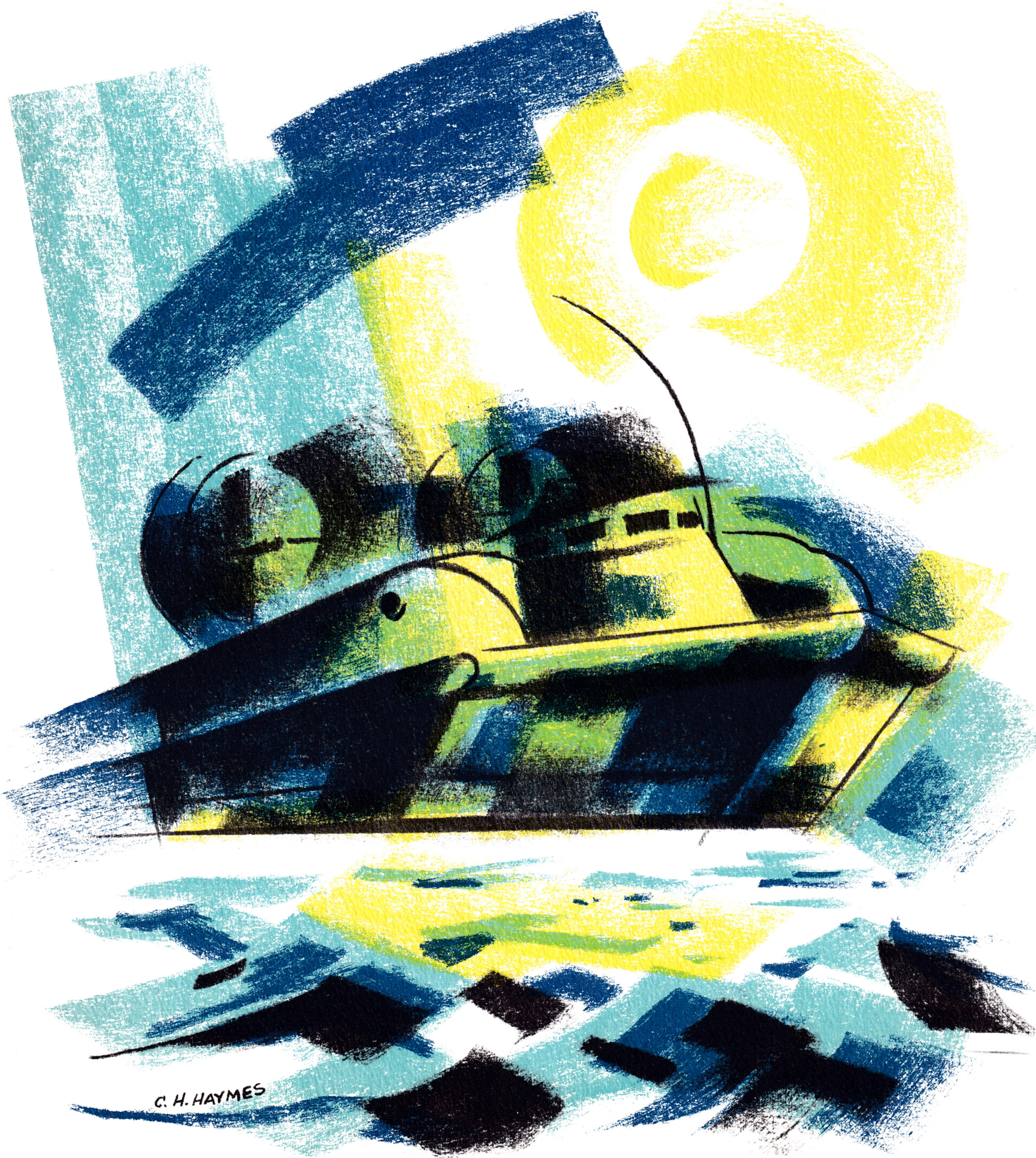


rendezvous

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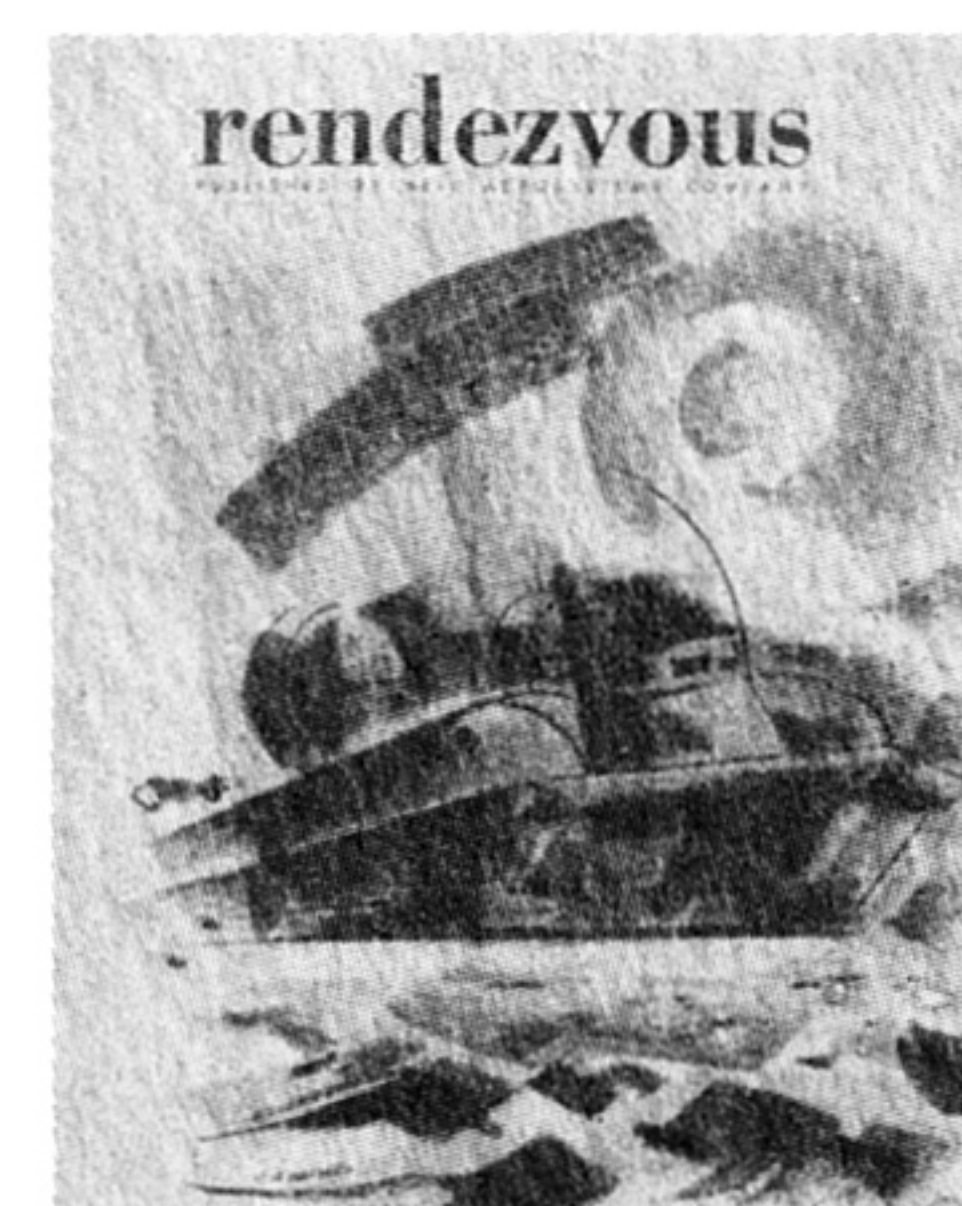
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COVER: Navy's SKMR-1,
the Bell Hydroskimmer,
from the palette of
Artist Charles Haymes.



SPACE AGE NEWS

IF THE U.S. IS TO LAND MEN ON MARS, it will probably be between 1973 and 1975 when earth and Mars will be closer to each other and in more favorable position to permit an inter-planetary voyage. Earth and Mars will not be in such favorable position again before 1984.

COST PER POUND OF AEROSPACE PRODUCTS has increased sharply since World War II, according to Aerospace Industries Association. During World War II, a period of very high production, cost was about \$10 per pound. In the 1950s the cost soared to more than \$100. Aerospace products today cost \$1,000 per pound. But there has been an even greater increase in the technological gains achieved.

PRELIMINARY DATA RECEIVED FROM NASA'S EXPLORER 17 indicates that earth's upper atmosphere contains a belt of neutral helium about 150 miles to 600 miles altitude. Previously, scientists believed that a band of oxygen and nitrogen gradually merged into an interplanetary atmosphere of hydrogen at that altitude.

METEOROLOGISTS CAN EXPECT to have regular and frequent information about earth's weather by 1965-66 when Nimbus weather satellites are orbiting and operational. Frequent observations are required for detection of brief weather phenomena such as thunderstorms and tornadoes.

BY DIGGING INTO POLAR SNOWS, man may be able to collect moon dust, according to an Ames Research Center expert. He claims the dust is falling on earth by the ton every day. His conclusions are based on a series of laboratory studies showing how matter travelling at high speed can hit rock and sand, spraying it out at a much higher speed than the projectile's. The same reaction may occur when speeding meteoroids strike the moon. Thus some of the lunar material might find its way into orbit around the earth with a small percent hitting the earth either soon after it leaves the moon or a month or so later.

BELL AEROSYSTEMS COMPANY HAS RECEIVED follow-on production orders amounting to more than \$5 million for its Agena rocket engine from Lockheed Missile and Space Company. The 16,000-pound thrust Agena, now being built on a production line basis at the Bell Wheatfield plant, has orbited more than 65 per cent of the U.S. Air Force and NASA satellites and has placed 80 per cent of the free world's functional payload in space. Agena has chalked up more than 100 firings in space since 1959.

INJUN 3 CONTINUES TO TRANSMIT DATA on artificial and natural radiation belts seven months after it was launched from Vandenberg AFB. The 24-inch sphere contains six solar cell patches. It was placed on elliptical orbit 153 to 1,729 miles above earth by Bell's Agena rocket engine. Designed to measure the "reservoir" of trapped radiation particles, the 114-pound vehicle is equipped with 18 radiation detectors and three photometers, magnetic orientation system, and two independent command and telemetry systems under ground command.

MERCURY . . . only the beginning!

By Albert W. Spindler

CAPE CANAVERAL, Florida—The voice of Lt. Col. John (Shorty) Powers, spokesman for Mercury Control, steadily monotoned the countdown over loudspeakers at the Press Site of the nation's spaceport here.

"T minus ten, nine, eight . . ."

All eyes were fixed upon the silvery Atlas booster with its black Mercury spacecraft payload on Launch Complex 14 about a mile away.

" . . . Three, two, one," Powers continued. "Ignition."

Black smoke belched from the bottom of the booster. The Atlas rose, slowly it seemed, from its pad.

"Liftoff," Powers announced.

Bright orange flame, partially obscured by the billowing smoke, shot downward as the rocket gained altitude, faster.

It tilted eastward over the Atlantic Ocean, got lost against the brilliant ball of sun for an instant, and reappeared as it headed higher into the cloudless sky. And then the rocket disappeared from sight.

And so, on the morning of May 15, the United States launched its sixth man into space.

Astronaut L. Gordon Cooper, at the controls of his Faith 7 Mercury spacecraft, was off on the 22-orbit, MA-9 mission of the National Aeronautics and Space Administration.

Cooper's flight covered nearly 600,000 miles from his perfect launch here to the precisely-executed recovery southeast of Midway Island in the Pacific Ocean. His spacecraft passed over more than 100 countries, islands and possessions. Total flight time was 34 hours, 20½ minutes — or almost four times longer than any previous American astronaut.

The MA-9 mission, which provided a dramatic finale to the Mercury program, was NASA's most ambitious manned space flight undertaking yet.

But plenty of know-how and confidence went along with the nation's sixth space-bound astronaut.

Cooper's flight was built on a solid

foundation of man-in-space experience that began with the two suborbital flights of Astronauts Alan B. Shepard Jr. and Virgil (Gus) Grissom in May and July 1961. They proved the reliability of the spacecraft, systems and procedures for these missions.

On Feb. 20, 1962, Astronaut John H. Glenn, Jr. made his historic three-orbit flight in his Friendship 7 spacecraft. By conducting experiments and by manually controlling his flight at times, he demonstrated that man could and should be more than a passenger in an automated space vehicle.

Three months later Astronaut M. Scott Carpenter duplicated the three-orbit mission, performed additional experiments and brought back more information about space and its effects upon man.

Then came the six-orbit flight of Astronaut Walter M. Schirra, Jr., who flew a near-perfect mission for more than nine hours on Oct. 3, 1962. He proved the capability of the Mercury spacecraft for longer missions.

Thus, in slightly more than two years from Shepard's 15-minute sub-orbital flight, NASA was fully prepared to embark upon a 22-orbit mission which would last nearly a day and a half.

Chief objectives of the Cooper mission were to study the effects on the astronaut of more than a day in weightless orbital flight; to verify that man can function as a primary "system" aboard the spacecraft for an extended period of time, and to evaluate the combined performance of the astronaut with a Mercury spacecraft which had been modified for a full-day mission.

From liftoff to landing, except for a 7½-hour sleeping period between the 9th and 14th orbits, Cooper was an unusually busy astronaut with a detailed flight plan packed with important experiments.

There was a whole series of aeromedical studies to evaluate the astronaut's responses to extended orbital flight conditions and to assess the adequacy of the spacecraft environ-

ment and its life support systems.

Cooper's statements and the data revealed to date indicate the astronaut passed the weightless test with flying colors. He withstood the prolonged weightlessness exceedingly well and reported no major discomfort during the flight.

Underlying the entire MA-9 mission was NASA's continuing effort to improve equipment, systems and procedures and acquire the knowledge and experience necessary to prepare for the much more advanced Gemini and Apollo programs.

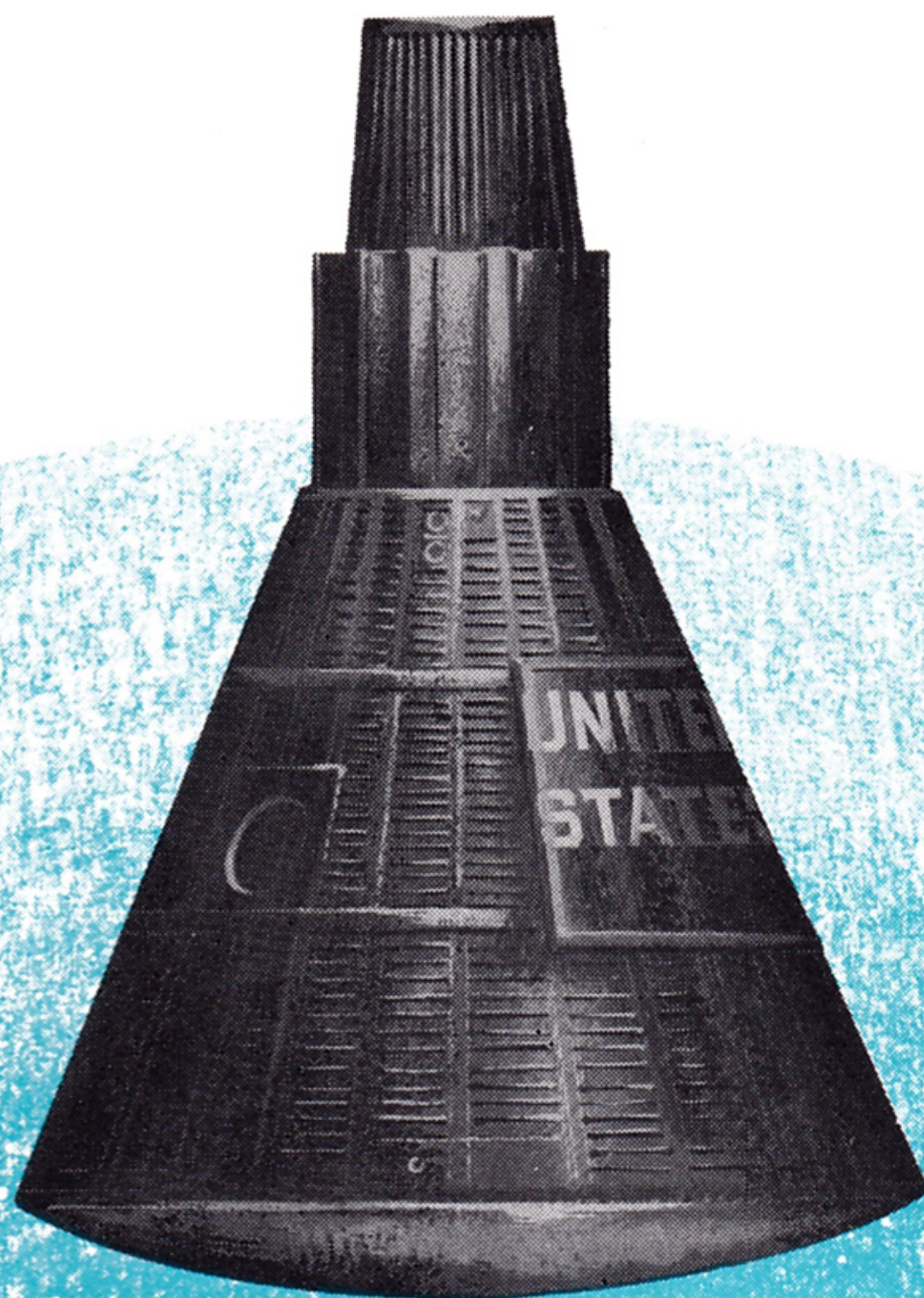
Project Gemini, slated to begin next year, features a spacecraft big enough to accommodate two men. It involves orbital missions as long as two weeks and will give astronauts experience in rendezvous and docking with the orbiting Agena D target vehicle. Gemini will also offer man a much greater role in space.

Even more complex is Project Apollo, the United States' program for manned exploration of the moon within this decade. All of the technology acquired in the Mercury and Gemini programs — and more — will be needed when three astronauts in a three-module Apollo spacecraft are launched from earth. First, all three will orbit the moon and then two astronauts will travel to the lunar surface in the Lunar Excursion Module (LEM). After a day or more on the moon, the astronauts will re-enter LEM, take off from the moon and rendezvous with the Apollo Command and Service modules which remained in lunar orbit. When the two astronauts return to the Command Module, the LEM will be jettisoned and the trio will journey back to earth.

Toward those long-term objectives, a number of important non-medical experiments were programmed for Astronaut Cooper on the MA-9 flight.

He deployed and later located a flashing beacon to demonstrate that light beacons could serve as a sighting aid for Gemini and Apollo spacecraft rendezvous maneuvers.

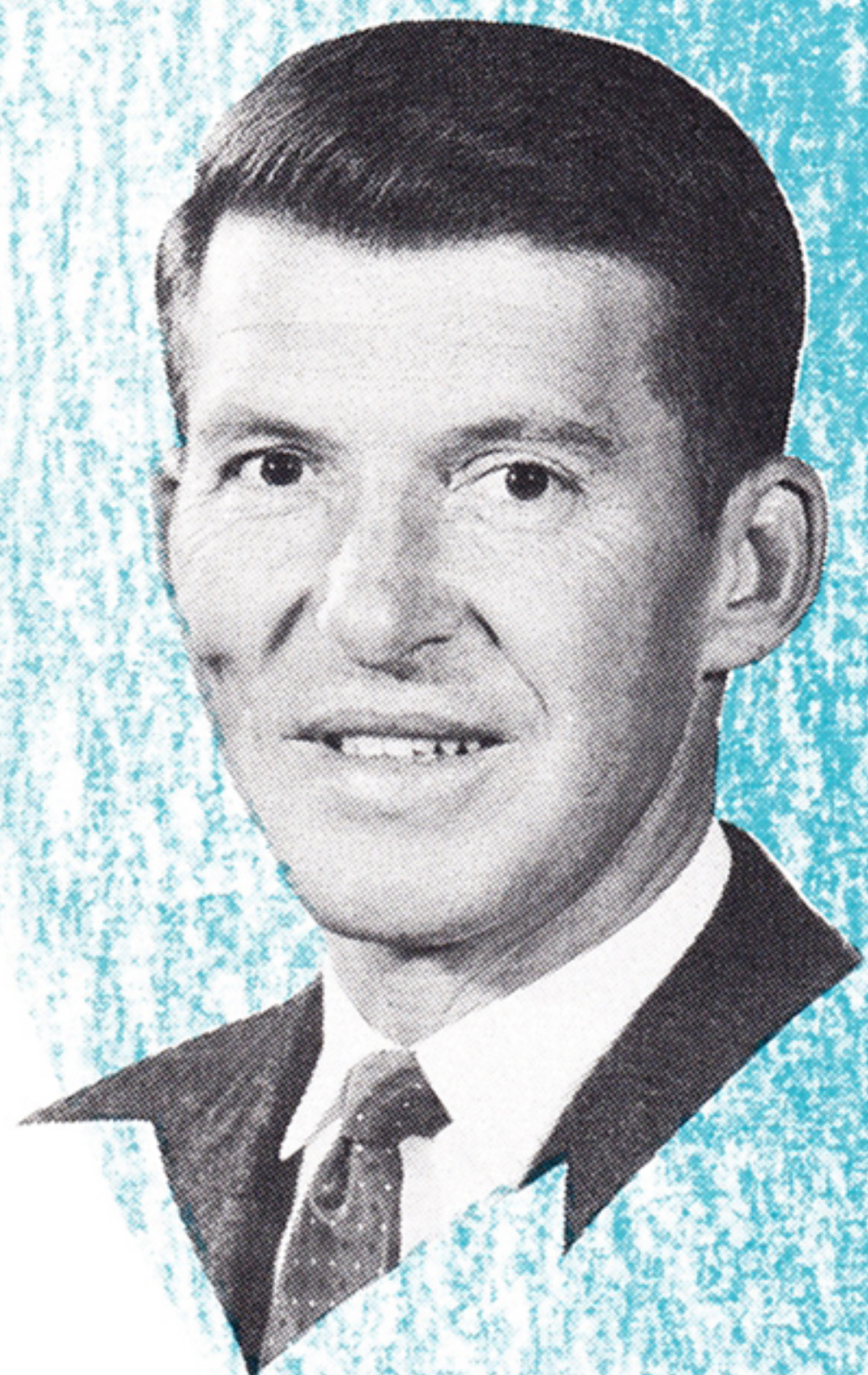
Cooper also spotted a high-intensity



MAJ. L. GORDON COOPER, JR., USAF
May 15, 1963 — 22 orbits
34 hours, 20 minutes, 30 seconds



LT. CDR. M. SCOTT CARPENTER, USN
May 24, 1962 — three orbits
4 hours, 53 minutes, 47 seconds



CDR. WALTER M. SCHIRRA, JR., USN
October 3, 1962 — six orbits
9 hours, 13 minutes



LT. COL. JOHN H. GLENN, JR., USMC
February 20, 1962 — three orbits
4 hours, 55 minutes, 23 seconds



CDR. ALAN B. SHEPARD, JR., USN
May 5, 1961
first manned U.S. space flight
suborbital — 254 miles



MAJ. VIRGIL I. GRISSOM, USAF
July 21, 1961
suborbital — 254 miles



MAJ. DONALD K. SLAYTON, USAF
Coordinator for Astronaut activities,
NASA Manned Spacecraft Center
Houston, Tex.

light while flying over South Africa, and this indicated the feasibility of using ground or high-altitude lights as navigation fixes for mid-course and near-earth corrections of the Apollo space vehicles.

A variety of photographic experiments were performed by the MA-9 astronaut. These ranged from dim light and horizon definition photos to infrared weather photography and the operation for the first time of a television camera in space.

Like all the previous American astronauts, Cooper used reaction controls designed and built by Textron's Bell Aerosystems Company as his "steering gear" in space.

The Bell reaction control system, an integral part of the McDonnell-built Mercury spacecraft, consists of 18 rocket motors with thrust levels of one-pound, six pounds and 24 pounds. Three sausage-shaped, positive expulsion tanks for the hydrogen peroxide fuel also were mounted in the capsule. The pressurization tanks and all valves for the system were provided by Bell.

At the astronaut's command or when activated by the Automatic Stabilization and Control System (ASCS), a valve opens and permits the hydrogen peroxide to pass over a silver catalyst bed in the rocket thrust chambers.

The fuel decomposes into superheated steam when allowed to escape from the rocket nozzles, provides a controllable amount of thrust to turn the spacecraft, pitch its nose up or down and roll it into whatever position the astronaut desires.

Cooper's first use of the Bell reaction controls came during the turnaround maneuver, just after the spacecraft was separated from its launch vehicle. He achieved orbital attitude by facing the blunt heat shield end of the capsule forward.

During this maneuver Astronaut Schirra, serving as capsule communicator at Mercury Control, commented:

"Faith 7, your turnaround looks beautiful."

Cooper responded: "Roger. Turning around very nicely. What a feeling. Boy, oh boy. And there's the booster."

A few seconds later the astronaut declared that the Bell reaction controls in the fly-by-wire mode were "working just like advertised."

Fly-by-wire, which has become almost a household word since Project Mercury began, identifies operation of the Bell reaction controls in the automatic system by response to electrical signals initiated by the astronaut's control stick. This manual signal input from the astronaut corresponds to the automatic signal normally received from the autopilot. Thus, there are two means of operating this system.

The astronaut also has the option of using a completely manual system, called manual proportional, in which he actually opens and closes the fuel valves by mechanical means:

Although much of the MA-9 mission was in "drifting flight," Cooper used the reaction controls whenever he had to position his spacecraft in a particular attitude to perform certain experiments. For example, the flashing beacon and photographic experiments required extensive use of the Bell control system.

Yet, as "Aviation Week & Space Technology" reported, Cooper did such an excellent job of reaction control fuel management that on the 21st orbit he reported to Glenn that 60 per cent of his automatic and 76 per cent of his manual fuel remained.

Attention again was focused on Cooper's skillful operation of the Bell Aerosystems reaction controls when he was forced to take over manual control of his Faith 7 spacecraft during the critical re-entry phase of his flight. A malfunction in the electrical system (later traced to moisture and corrosion in two electrical connectors) prevented use of the ASCS mode during re-entry.

This meant that the astronaut had to execute a complex series of jobs, in rapid-fire fashion, which are ordinarily done by the automatic system.

Cooper, during his news conference here three days after recovery, gave his own account of those tension-packed minutes of re-entry. Here are the astronaut's own words:

"I came out into the first light of the 22nd orbit. John Glenn counted me down on the retro fire . . .

"I had everything all set and on the zero count punched the retros and they fired with a good, strong thump and I guess I held them fairly close on because we hit pretty close there.

"And then I was intending to fly by wire for re-entry. However, I did not quite like the slowness that the fly-by-wire big thrusters lit off as I'd stated previously, and it's perhaps my fault for not running it through a little bit earlier.

"But I was somewhat busy making sure I was in retro attitude and so I switched over to dual authority using the manual proportional to back up my fly-by-wire and ran the re-entry.

"I found that the re-entry was easier through the first portion than what we've been practicing . . . in the previous trainers with the computers.

"As I held re-entry attitude and started on in, the spacecraft felt that it wanted to start re-entering and it got a little mushy on the controls.

"I applied the proper roll rate at this time and let it go ahead and start.

"Very shortly thereafter I noted a lot of burning particles coming past and considerable heat on — it occurred to be heat on the outside. One retro strap came flying over and set there right in front of the window and proceeded to get warmer, and got red hot, and white hot and then broke into several pieces and floated away.

"I noted the fireball that John Glenn had described oscillating to the rear of the spacecraft, in fairly close, I thought. But it really was no problem, I mean I was expecting it to be

out there. I think that it's probably in the wake, back in this hypervelocity wake of the spacecraft as you begin to pick this up on re-entry.

"Everything went very normally. The oscillations were held fairly close and I felt that the re-entry Gs were no problem at all. I know we had conjectured as to whether after a prolonged period of weightlessness whether re-entry would be any real problem. I don't feel it was any different from what we'd done on the centrifuge.

"I was able to keep the instruments in good clear focus and I was aware of what was going on all the time. In fact, very shortly thereafter I was talking to Scotty Carpenter on the radio in Hawaii and the rates of roll picked up as they should immediately after the max G point; which is an area where the spacecraft becomes a little more unstable, and I was able to, I was glad that I had the dual authority.

"The fly-by-wire was working perfectly by this time, so I had dual authority or 48 pounds of thrust on these axes, by this time. And I held the rate not as close as I would like to have held them, but I held them reasonably close, and the oscillations were not objectionable at all.

"I had planned on deploying the drogue chute manually at 42,000 feet which I did, and we were in the clouds and then I could see the drogue very clearly. It came out with a big rattle and roar and a thump, and then the main chute deployed itself . . . at about 11,000 feet.

"It was a good main (chute) and the minute it deployed, two helicopters were orbiting around me slightly below me and starting calling off my altitudes . . ."

Astronaut Cooper executed all of the tasks during that critical re-entry period with such perfection that he landed in the Pacific Ocean a scant 7,000 yards from his prime recovery ship, the aircraft carrier Kearsarge.

"Right on the old bazoo," as Cooper



described his own landing.

Astronaut Cooper's successful completion of the MA-9 mission provided a dramatic climax to the United States' initial effort to build and fly a manned spacecraft.

Upon the basis of all the knowledge and experience obtained from Project Mercury, Project Gemini will be launched as an operating system to

familiarize man with other aspects of working in space.

The lessons learned from Mercury will be applied to future space programs to cut down the time needed for basic research and allow man to get on with the main task of exploring space, leading up to Apollo and man's first landing on the moon.



VTOL

BREACHING NEW FLIGHT BARRIERS

By

James A. O'Malley, Jr.

*Assistant Manager of Aerospace Marketing
And Chief of Aircraft Systems*

IN THE area of experimental aircraft research, the name of Bell has long been known for its ability to breach barriers of technology once believed impenetrable. Since the day of the first Bell helicopter and the P-59, America's first jet aircraft, few challenges have daunted Bell designers and engineers.

Off Bell drawing boards in rapid succession came the world's first supersonic rocket planes, the X-1, X-1A and X-2, which conquered the sound and heat barriers flying higher and faster than man had flown before. Thirteen years ago the Bell X-5 proved the feasibility of in-flight variable swept-back wing aircraft, a concept only now gaining popularity in the TFX-type fighters.

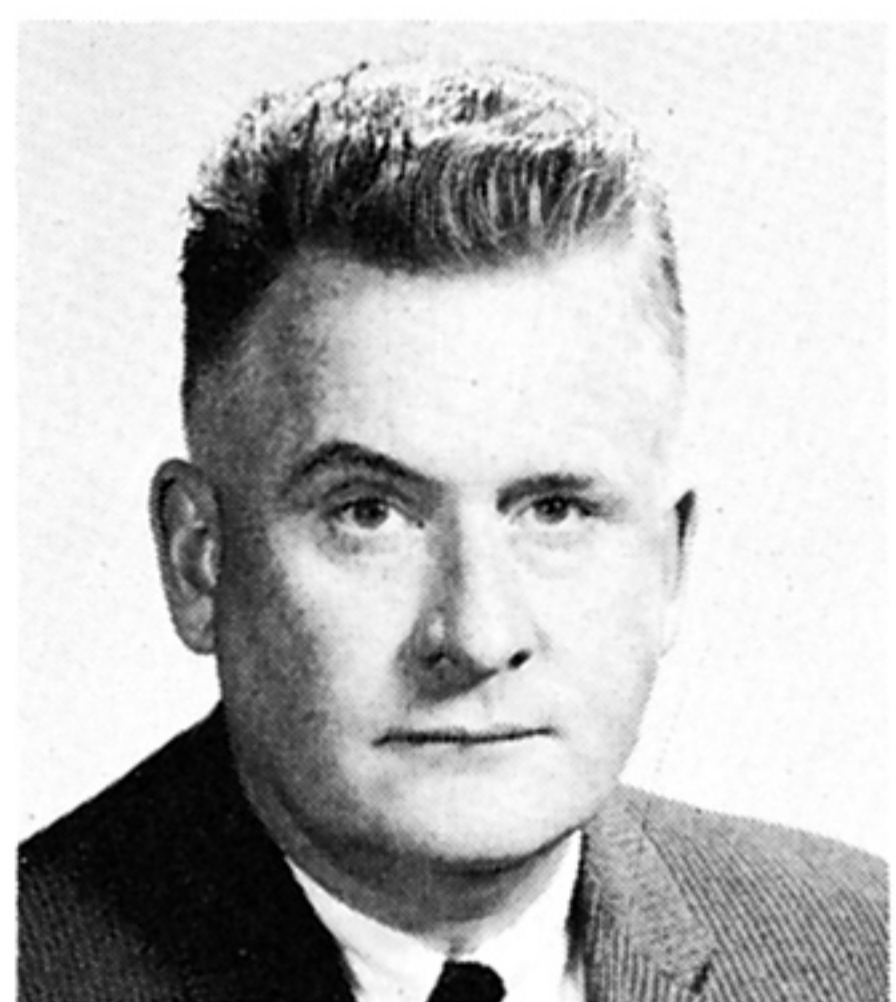
These vast research programs which produced so many aviation "firsts" quite logically spurred the company ten years ago into the position of U.S. pioneer in the vertical and short take-off and landing (V/STOL) aircraft. Today V/STOL aircraft are coming into increasing prominence in world aviation as was so clearly evident at the recent International Aviation and Space Exposition in Paris.

Thomas Edison is reputed to have said that "the airplane will only be half invented until it can takeoff and land without runways." The need for V/STOL aircraft has been apparent ever since the Wright Brothers made history at Kitty Hawk 60 years ago.

The V/STOL concept, it seems to me, springs from the same requirements which led us to develop track-type vehicles, such as the tank, specially designed to operate without roads. A weapon of modern war should not be tied to acres of concrete which require tremendous effort and initial investment, attract aggressors as inviting targets, and are practically irreplaceable in the time span of battle.

I am also quite convinced that we cannot replace the hunter with his rifle by a cannon and still expect to go rabbit hunting. The spread of limited wars requires effective, highly mobile tools to operate in the most isolated areas of the world.

There can be no doubt that militarily and commercially the development of the capability to take off and land on a precise spot will provide a valuable advance to aviation. Other countries have seen this fact perhaps more clearly than we.



James A. O'Malley, Jr., assistant manager of Bell Aerospace Marketing and Chief of Aircraft Systems, has been intimately associated with Bell VTOL projects since he joined

the company in 1947. He contributed to the aerodynamic analysis of the Model 47E Helicopter, preliminary convertiplane configurations, and the X-1A rocket research airplane. He was project aerodynamicist on the variable sweepback X-5 and VTOL Air Test Vehicle. From 1952 to 1956 he was responsible for directing all aerodynamic propulsion, and flight control analysis and test work on the Bell VTOL designs including the X-14, ducted propeller transports and designs leading to the D-188A fighter and X-22A transport, all of which he discusses in this article. In his present position since 1961, he is concerned with the international market for V/STOL aircraft. He holds a Masters degree in aeronautical engineering from the University of Michigan and a Masters in business administration from the University of Buffalo.

Bell was an early contributor to the V/STOL field. It was the first company to propose the use of jet engines in a VTOL employing normal horizontal fuselage position during takeoff. Feasibility studies conducted for the Air Force led Bell engineers to the conclusion that they could build a V/STOL based on the then available state-of-the-art. A company-funded jet VTOL airplane called the Air Test Vehicle was built to prove that conclusion. It became the first jet V/STOL airplane to fly anywhere in the world.



ATV

Completed late in 1953, the Air Test Vehicle flew in 1954. It demonstrated the capability of this design, which used rotating jet engines, to accomplish a hovering takeoff and forward flight as a conventional jet.

Meanwhile other Bell engineers had been busy designing an altogether different type of VTOL, the XV-3 Convertiplane, a tilt rotor concept. The original mockup was constructed in Buffalo but the aircraft was built in Fort Worth after Bell's helicopter division relocated in Texas. The XV-3 completed ten years of flight tests before being moved to NASA's Ames Laboratory where it is still flying. Much of the control design required for aircraft with rotatable thrust systems was pioneered on this aircraft.

As a result of the Air Test Vehicle program, Bell's independent proposal to build a 3,000-pound X-14 airplane for the Air Force was approved. Using a deflected-thrust technique to attain its VTOL ability, the twin-jet X-14 made its first hovering flights in 1957 and transition flights in 1958. Still flying, after providing a maximum of

data for V/STOL design techniques, the X-14A is now being tested by the National Aeronautics and Space Administration as a lunar landing trainer at Ames Research Center, Moffett AFB, Calif. All branches of the military and NATO allies have utilized the training capabilities of the X-14A.

Because of its excellent record, trainer versions of this two-place aircraft as well as tactical versions for limited war applications have been proposed to the U.S. military and to some foreign governments.

From 1953 to 1956 Bell made detailed design studies of jet V/STOL fighters based on (1) the single engine vectored thrust principle and (2) the multiple lifting engine concepts. Significant weight and performance advantages were found when these were synthesized in the design of a combined system in the D-188A or XF-109 jet fighter-bomber in 1956. Funded jointly by Bell and bi-service Air Force and Navy sponsorship, the 30,000-pound, eight-engine D-188A was designed for speeds of Mach 2.3 as a deck-ready Navy interceptor and as a tactical fighter-bomber for the Air Force. This airplane weapon system was carried through to a detailed mockup inspection and represents this country's most extensive effort to date devoted to V/STOL.

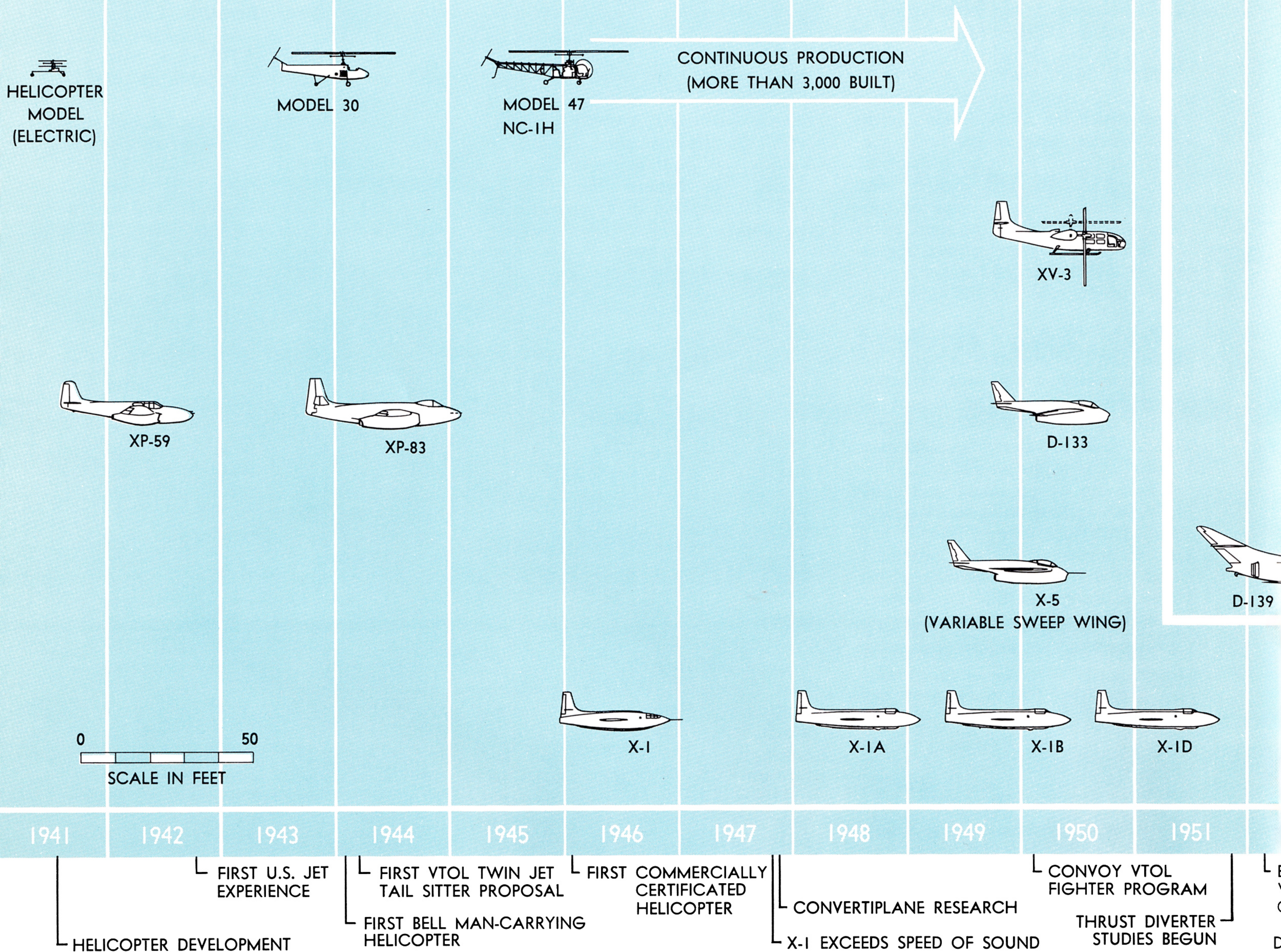
Had the aircraft been built, it could have been flying in the summer of 1961 and data from these flights could now be incorporated in an operational jet VTOL fighter.

As a separate effort for transport applications, Bell started studies in 1953 on the ducted propeller concept of VTOL aircraft. This effort reached fruition in the award of the Navy tri-service X-22A research transport contract last year.

Recognizing the advantages of ducted propellers for V/STOL flight, the Navy awarded Bell a one-year study contract in 1957 for a ducted propeller assault transport with vertical flight capability. Many design studies and proposals for transport, observation, rescue and utility aircraft applications resulted.

One of the most significant among them was the D-190 series of aircraft for air-rescue type vehicles. After an unpaid study of this problem, the Air Force requested Bell to continue further development of the D-190 and

SPECTRUM OF BELL FLIGHT EXPERIENCE



work closely with Air Rescue Service over a four-year period. Based upon the military evaluation of this airplane in 1959, Air Research and Development Command recommended that the Air Force seriously consider continuing its development.

The 15,000-pound D-190 is designed to fit beneath a C-130 transport which would carry it to a search area before launching it to accomplish

ocean rescue. After plucking survivors from the sea, the D-190 would return to its berth beneath the C-130 for the return trip to base.

In addition to rescue missions, the D-190 is designed to serve as a nine-passenger transport and could be used as a personnel carrier for many different general purpose missions such as liaison and light logistics support.

Continued research in the ducted

propeller field brought about the design of the tandem ducted propeller D-2005 VTOL in the summer of 1959. It was informally submitted to the Marine Corps as an assault transport. A formal proposal of a somewhat similar craft, the D-2022, was submitted in 1960 as an Army aircraft version.

Noting the requirements in various services, an Ad Hoc Committee on

Local Chapters ARS, IAS Join

The local chapters of the two principal professional organizations of aerospace industry engineers, the American Rocket Society and the Institute of the Aerospace Sciences, has joined forces to become the Niagara Frontier Section of the American Institute of Aeronautics and Astronautics (AIAA).

The local merger followed amalgamation of the ARS and IAS on a nationwide basis earlier this year.

With the merger of the two local professional societies, membership in the new AIAA section now numbers nearly 400. Approximately 120 members are employees of Textron's Bell Aerosystems Company.

Richard P. White Jr. of Cornell Aeronautical Laboratory was elected the first chairman of the new section. He outlined the major objectives of the AIAA, both locally and nationally, as furthering the professional development of those engaged in scientific and engineering activities, improving public understanding of the professions and promoting communications among engineers and scientists and with other professional groups.

Three of the five officers of the new AIAA section are from Bell Aerosystems. They are Daniel Y. Sing, vice chairman; Richard H. Gallagher, recording secretary, and Daniel J. Fabricy Jr., corresponding secretary.

Five other Bell employees hold seats on the AIAA council. They are Robert D. Roach Jr., James A. O'Malley Jr., John M. Cord, Frederick A. Boorady and Craig M. Schmidt.

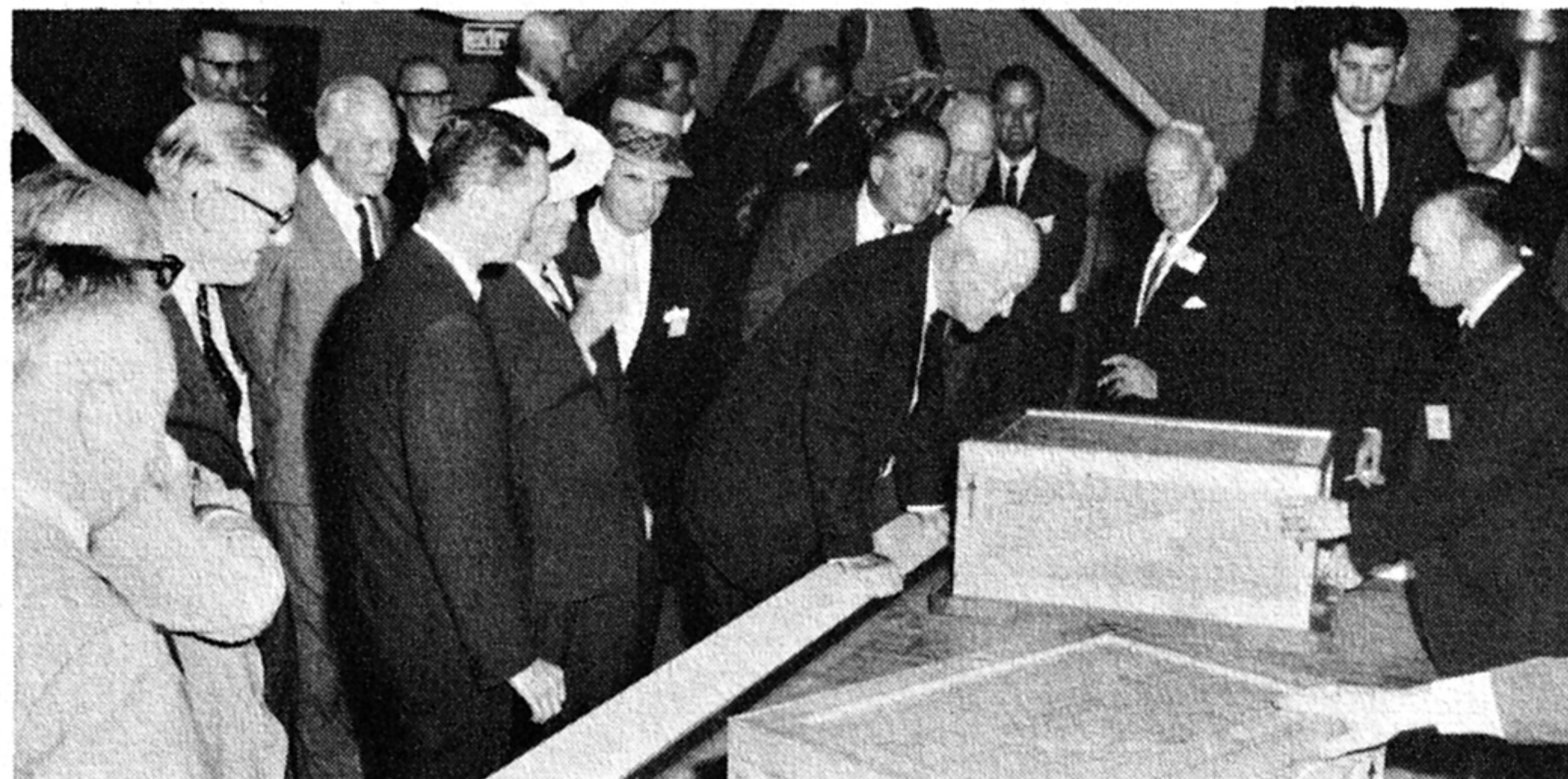
Before the merger, Boorady was chairman of the local ARS section and Schmidt was the IAS section chairman.

Roach served as chairman of the inaugural dinner-dance, where the new AIAA section's first slate of officers was installed.

Textron Ranks 94th

Textron Inc., Bell's parent company, is listed as the 94th largest U.S. corporation in the annual industry directory just published by Fortune Magazine.

Corporate Directors Meet at Bell



Textron directors and company officers witness a demonstration by Marvin F. DeBoy (right), human factors section, of the Air Conveyor developed to move loads on a thin cushion of air provided when the pallet moves across the tiny pressurized air holes in the floor.

Sloan Fellow Piselli Returns As Director of Engineering

Joseph R. Piselli, who joined Bell 16 years ago as a rockets research engineer, has been appointed Director of Engineering for the Aerospace-Rockets Division.



Promotion of Piselli to his new position was announced by William M. Smith, vice president and division manager, shortly after the veteran Bell engineer was awarded a master of science degree in Industrial Management by Massachusetts Institute of Technology.

Piselli was selected as a Sloan Fellow last year and, under company sponsorship, spent the 1962-63 academic year at the M.I.T. School of Industrial Management, Cambridge, Mass. The Sloan Fellowship program is devoted to intensive study of modern business and industrial management techniques.

He began his career with Bell in 1947 and served as a group leader of rocket engine design and development. In 1952, he was named assistant section leader for all

rocket engine development, including the Shrike, Rascal, Nike, Hustler and high-energy engines.

Piselli established and became manager of the Rockets Marketing Department in 1956, and in 1959 and 1960 he served as manager of marketing for the combined Aerospace-Rockets Division.

In 1960, Piselli was appointed associate chief engineer of Aerospace Engineering, the post he held when selected for the Sloan Fellowship.

A native of Newton, Mass., Piselli received his bachelor of science degree in mechanical engineering from Northeastern University, Boston, in 1944 and his master of science degree in mechanical engineering from Harvard University in 1947.

Bell Wins Safety Award

Bell's safety record during the first three months of this year was rewarded June 13 with a Certificate of Achievement presented by the Associated Industries of New York to Thomas R. Leadbeater, safety supervisor, at a Buffalo Area Chamber of Commerce dinner in Buffalo's Hotel Statler Hilton. The certificate was presented in recognition of Bell's "better than average experience" in number and frequency of lost time accidents during that period.

Review Company Projects, See Rocket Belt Flight, Watch Agena Engine Fire

The board of directors of Textron Inc. made their first visit to Bell Aerosystems Company in late June.

The visitors, who oversee the operations of one of the nation's top 100 corporations, spent six hours reviewing the company's activities and expressed confidence that Bell is meeting the challenges of the Space Age and fulfilling its responsibility to Textron shareholders.

Bell President William G. Gisell, who accompanied the Textron and Bell Aerospace directors during their tour of Bell facilities on the Niagara Frontier, said the visitors were very impressed with the work Bell employees are doing.

"I want to thank everyone for making the visit so successful," Gisell said. "The confidence and support of members of both boards was strengthened by the visit," he added.

Rupert C. Thompson Jr., chairman of the Textron board of directors, expressed his enthusiasm for Bell Aerosystems' operations during a press conference at the conclusion of the visit. He told reporters:

"We were enthusiastic in 1960 when we acquired the defense business of Bell Aircraft, and we are even more enthusiastic now in that the plant represents one of our fastest growing units."

He noted that Bell has broadened its base of participation considerably since becoming a part of Textron, and the company's overall volume is well above what it was in 1960.

"Bell started out with three product lines and now numbers more than a dozen," Textron President George William Miller explained.

The directors and other officials of Textron and Bell Aerospace arrived by airplane on the morning of June 26.

There were brief meetings of both boards, followed by a series of special demonstrations and presentations to show the directors the programs now under way at Bell.

(continued page 3)



Vice President William M. Smith, manager of the Aerospace-Rockets Division, and Charles T. Kessing, program manager for the Apollo positive expulsion contract, were among top management representatives of subcontractors who participated in Project Apollo meetings at North American Aviation's Space and Information Systems Division, Downey, Calif. Bell has a subcontract to design and build the positive expulsion tanks for Apollo's reaction control system. From left are N. C. Glavinich, Smith, F. W. Hobson, C. M. Myers, Kessing and R. D. Burge. All but Smith and Kessing are North American representatives.

Avionics Experts Help French With ALS Test Program

Four Avionics specialists are in France assisting the French government in its flight test program with the Bell all-weather, automatic landing system. The system was shipped to France late in May for a year's evaluation.

It is being tested at France's joint civil-military Centre D'Essais en Vol (Flight Test Center) at Bretigny southeast of Paris.

The four Bell specialists are: Donald Femiano, project engineer; James E. Junkin, maintenance and opera-

tions representative; Frederic D. Powell, system engineer and Gerald Flemming, aircraft suitability engineer.

Powell and Flemming will return to Wheatfield after three months. Femiano and Junkin will remain in France during the entire year's evaluation. Both have their families with them.

The ALS leased to France is similar to that developed by Bell for the U.S. Navy and Air Force. It was built with company funds as an engineering evaluation.



NASA's chief research pilot, Joseph A. Walker, record-breaking pilot of the X-15 rocket research airplane, examines a model of the Bell lunar landing research vehicle on a recent visit to Wheatfield. Walker will be project pilot for the program when the craft are flown at NASA Flight Research Center, Edwards, Calif. Bell will build two lunar landing research vehicles in support of Project Apollo.

Two High School Students Win Bell Scholarships

Two area high school students, who won the top prizes in the 21st Science Congress of Western New York, were given Lawrence D. Bell Scholarships recently by Bell Aerosystems Company.

The scholarships were awarded to:

Nadeen K. Meyer of 116 Somerton Ave., Town of Tonawanda, a student at Kenmore West Senior High School.

Martin Kasprzyk of Strykersville, a student at Holland Central School.

Miss Meyer presented at the Science Congress a lecture-demonstration entitled, "A Chromatographic Analysis of Mutant Pigment in

Serratia Marascens." Her paper was based on a study of a type of bacteria that produces red pigment and lengthy experimentation comparing color changes.

Martin Kasprzyk won the top award in the Physics category with a paper entitled, "The Design of Solid Propellant Rocket Motors." Martin conducted a lengthy series of experiments with solid propellants, and based his paper on the results of his work.

Bell offers the scholarships amounting to \$100 a piece, each year to encourage interest and participation in science by talented youth of Western New York.



Martin Kasprzyk, a top award winner of the 21st Science Congress of Western New York, receives from Vice President Peter J. Wacks a Lawrence D. Bell scholarship presented each year to encourage talented youth.

Former USAF General Named Textron VP

Thomas C. Musgrave, Jr., former Air Force major general, has been named a vice president of Textron responsible for coordination and planning of the company's defense production activities.

Based in Washington, D.C., Musgrave will work under Harvey Gaylord, president of Bell Aerospace Corporation and executive vice president of Textron.

Since his retirement from the Air Force, General Musgrave has been associated with the investment firm of Auchincloss, Parker and Redpath in Washington.

He is a 1935 graduate of the U.S. Military Academy and held several command assignments in the Pacific in World War II. Following the war he commanded air divisions in the U.S. and held assignments at Air Force headquarters in Washington.

Astronaut Cooper Sends Bell Best Regards

Shortly after learning of the successful completion of Astronaut Gordon Cooper's MA-9 Mercury orbital flight, Bell's Vice President William M. Smith, Aerospace/Rockets Division, sent Cooper congratulations on behalf of the company. Cooper replied:

"My sincere thanks for your recent letter and the kind remarks. The response to my flight has been overwhelming and I deeply appreciate all of the wonderful letters I have received.

"I feel, however, that the credit for this accomplishment belongs to the thousands of dedicated people who comprise the entire space program. Without their support and untiring efforts, it would not have been possible.

"My best regards to Mr. Gisel and all the wonderful people at Bell Aerosystems."

(continued from page 1)

They saw Peter L. Kedzierski, 19-year-old Bell Rocket Belt operator, fly over two trees from the Data Processing Building to the lawn in front of the Administration Building at an altitude of more than 30 feet.

Next came a test firing of the Bell Agena rocket engine to show the 16,000-pound-thrust space propulsion system in action.

In the Mockup Area, the Aerospace-Rockets and Avionics Divisions had hardware for many current projects on display and specialists in all fields of Bell activity were there to describe the work the company is doing on national defense and space exploration programs.

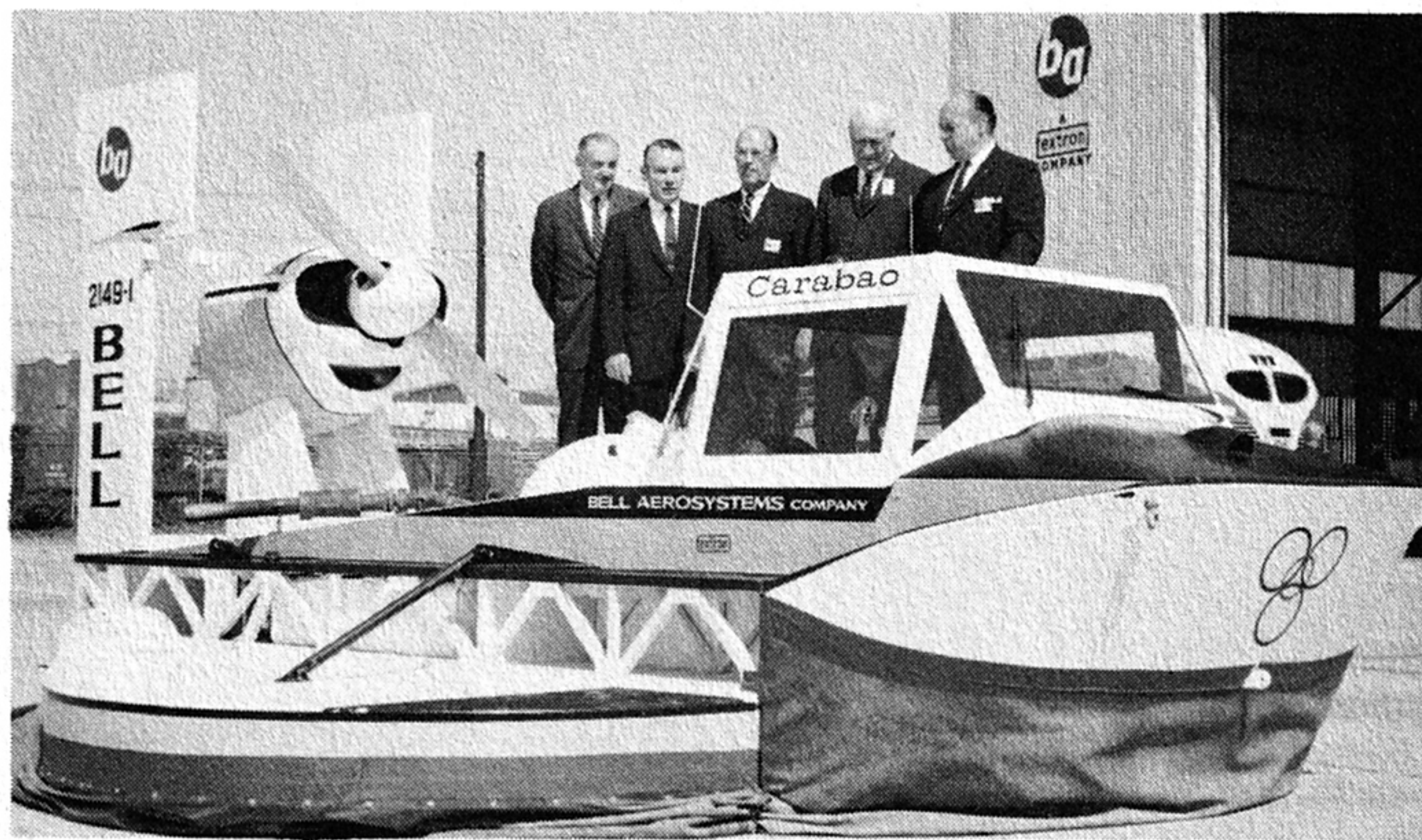
The visitors traveled by bus to the Bell Hydroskimmer Test Base on the Buffalo waterfront for their first look at the 22½-ton Hydroskimmer the company built for the U.S. Navy Bureau of Ships.

Test Pilot William Callan demonstrated for the visitors Bell's smaller ground effect machine, the Carabao, at speeds up to 50 miles per hour on Lake Erie.

Textron directors who attended the board meeting here were John E. Bierwirth, chairman of the board of National Distillers and Chemical Corporation, New York City; Frederick S. Blackall Jr., chairman of the board of Taft-Pierce Manufacturing Company, Woonsocket, R. I.; Frederic C. Church, Senior Partner of Boit, Dalton & Church of Boston; Henry C. Flower Jr., retired vice chairman of the J. Walter Thompson Company, New York City; Harry B. Freeman, chairman of the board of Rhode Island Hospital Trust Company, Providence; Norman B. Frost of Frost & Towers, Washington attorneys; Herman E. Goodman, president of the Franklin Corporation, New York City; Robert L. Huffines Jr., chairman of the board of the Worth Fund Inc., New York City; President Miller, and Chairman Thompson.

Other Textron officials who visited Bell were Royal Little, founder and retired board chairman; Robert R. Thurber, vice president and secretary, and Douglas L. Grote, treasurer.

The Bell Aerospace directors who attended the board meeting were Secretary Mason O. Damon, Leston Faneuf, former board chairman of Bell Aircraft; Harvey Gaylord, Bell Aerospace president and executive vice president of Textron; and J. Fred Schoellkopf IV, president of Niagara Share Corporation of Buffalo.



Inspecting the new Carabao at Buffalo Harbor test base are (l to r): Harvey Gaylord, Bell Aerospace president; George William Miller, Textron president; Rupert C. Thompson, Jr., Textron Board Chairman; John E. Bierwirth, director; and William G. Gisell, Bell Aerosystems president.

Bell Speakers Bureau Continues Busy Spring-Summer Schedule

Two of Bell's vice presidents stressed the importance of higher education for today's youth to prepare to meet the challenges of the Space Age in recent speeches in the Niagara Falls area.

William M. Smith, manager of the Aerospace/Rockets Division, addressed more than 200 teachers and community leaders at the annual Teachers' Recognition Day luncheon of the Niagara Falls Junior Chamber of Commerce in the Hotel Niagara on May 21.

He emphasized that a college education is necessary if young people expect to obtain significant employment in the future. The high degree of job specialization and automation will practically eliminate many of the menial occupations we know today, Smith explained.

"Letting Go" was the theme of a commencement address given by John H. van Lonkhuyzen, manager of the Avionics Division, to graduates of the Niagara-Wheatfield Central High School.

Suggesting that the next 10 years will set the pattern of how they live the rest of their lives, van Lonkhuyzen advised the 186 graduates to "let go" mentally to meet the challenges of science and the Space Age. He cautioned the youths against being moderate in their work, convictions and education.

Thirty-two other speaking engagements were fulfilled during April, May and June by Bell Aerosystems' employees. Charles F. Kreiner of the Public Relations Department, coordinator of the Bell Speakers' Bureau, reported that Bell speakers addressed audiences totalling nearly 7,000 during the three-month period.

Speakers and the groups

they addressed include:

Walter A. McMurry — Griffith Institute Faculty Assn., Springville; Society of American Military Engineers, Buffalo; Masonic Luncheon Club, Buffalo; Roswell Society of Surgeons, Buffalo; American Petroleum Institute, Detroit, and the American Society of Civil Engineers, Buffalo.

Robert D. Roach, Jr. — Sylvania Engineering Club, Williamsville; Joe Berg Seminar Foundation, Niagara Falls; Niagara Mohawk Foremen's Club, Buffalo, and the Benjamin Franklin Junior High School, Town of Tonawanda.

Dr. Walter R. Dornberger — American Rocket Society and the American Society of Mechanical Engineers at the NASA Lewis Research Center, Cleveland; American Legion Naturalization Day, Lancaster, Pa., and American Institute for Aeronautics and Astronautics at Huntsville, Pa.

Peter J. Wacks — National Metal Trades Assn., Syracuse, and the Frontier Club of Republican Women, Buffalo.

William W. Swenson —

If you have any ideas you believe would be useful to the company and the industry, you should know about a CDS.

That's the form provided by the company on which employees are urged to disclose new ideas and inventions.

The Conception Data Sheet is available in the Patent Department. When completed, the CDS should be forwarded directly to the Patent Department for evaluation.

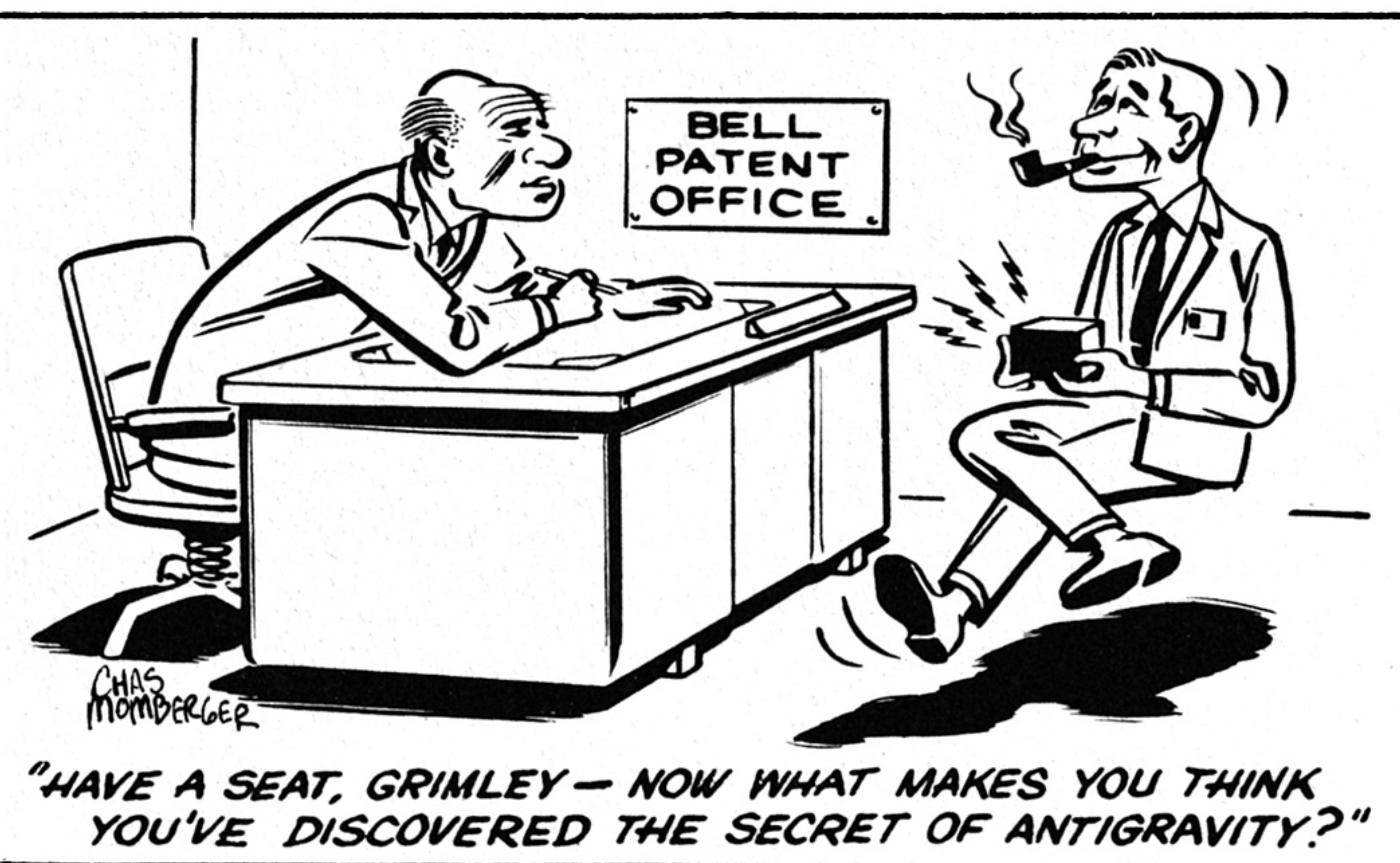
Patent specialists point out that the only signatures required on a CDS are those of one witness and three others who know and preferably understand the idea. Contrary to some opinion, the signature of the employee's supervisor is not required.

Young People's Club of Westminster Church, Buffalo, and South Buffalo YMCA.

Thomas P. Glynn — Newfane lodge and First Evangelical Church, Niagara Falls.

Robert F. Courter, Jr. and Peter L. Kedzierski — Young People's Club of Westminster Church, Buffalo, and Middleport Rotary Club.

Victor F. Emerson, Academy School, Williamsville; Herbert Rosebrock, St. Matthew's Christian School, North Tonawanda; George B. Melrose, Cleveland Hill High School, Cheektowaga; Frank Liberto, St. Andrew's Holy Name Society, Tonawanda; John V. Robinson, Lions Club of West Seneca; John H. van Lonkhuyzen, Holland Club of the International Institute, Buffalo; Dr. Richard A. Ibi-son, Grace Lutheran Church, North Tonawanda; Charles Janoff, Temple Sinai; Frank J. Lenton, Kenilworth Volunteer Fire Department, Town of Tonawanda; John J. Geary, YMCA Quarter Century Club, Buffalo, and Raymond E. Carroll, New York State Regional Conference on Industrial Modernization.



Company Airplane Logs 50,000 Miles ; Gilmore Appointed Manager

Nearly 50,000 passenger miles and 100 hours of flight time has been logged so far in the new Beechcraft Queen Air acquired by Bell Aerosystems to provide efficient and economical transportation for employees on business trips.

The new airplane has been in Bell service since May 1, and is operated by the Flight Research Department.

A regularly scheduled flight from the Bell Wheatfield

plant to Washington, D.C. and return is made every Thursday.

Special flights to other destinations within 600 miles of Niagara Falls can be arranged for groups of three to five employees.

The Bell Transportation Department processes the travel authorizations and reserves the aircraft for special non-scheduled flights.

The company airplane is

operated under the same regulations as all commercial charter and scheduled carriers.

Allen G. (Blackie) Gilmore, newly-appointed manager of flight operations, is responsible for the operation of the new Queen Air and all other company aircraft.

"Our aim is to provide Bell employees with fast, convenient business transportation at low cost to the company," Gilmore explained.

Gilmore, who accumulated more than 12,000 hours of flight time during 21 years in the U.S. Navy, serves as chief pilot of the Queen Air.

He joined Bell Aerosystems recently after retiring from the Navy with the rank of commander. Gilmore's last as-

signment was as training and flight operations officer for the Glenview, Ill., Naval Air Station, where he was responsible for the flight training of 5,000 Navy reservists in 31 squadrons.

Prior to that assignment Gilmore served for 17 years with the Military Air Transport Service (MATS), flying to destinations throughout the world. He flew in the Berlin Airlift during 1948 and 1949.

Gilmore entered the Navy in July 1942 as an aviation cadet and after graduation from the Naval Air Training Center at Corpus Christi, Texas, was a dive bomber pilot in the Pacific Theater during World War II.



A. G. (Blackie) Gilmore, new chief of flight operations (left), and David W. Howe, test pilot, review the log of Bell's twin-engine Beechcraft Queen-Air which has logged 50,000 passenger miles since it was acquired May 1.

Engineer Wins Golf Trophy



Nels W. Larson, (right) weights engineer in Rockets Engineering, receives the President's Trophy from William G. Gisel which Larson won at the 17th annual summer golf tournament of the Bell Golf Club at Hyde Park Golf Course, Niagara Falls. It was the first presentation of the trophy which is to be an annual affair. More than 90 golfers participated. At a dinner following the tourney, 39 prizes were awarded.

Monthly Housekeeping Inspection Awards System Inaugurated

Plant housekeeping is expected to be improved with the recent inauguration of a monthly inspection by three management - designated teams to determine which department of each division it keeping its house in best order.

First month's winners were: Aerospace/Rockets Weld Shop, Avionics Estimating, Quality and Material Control, and Technical Publications.

Second month winners were: A/R valve assembly shop, Avionics SPN/10 summation networks, and cost accounting, property records and accounts receivable departments for the general office area.

Winning departments received a large Presidential Trophy which is to be displayed in a prominent spot within the department for one month. Members of the winning department receive

individual awards for their cooperation.

Inspection committees are made up of:

Aerospace/Rockets: M. Sill, chairman; Leo Buckley

Avionics: Bill Heavner, chairman; Tom Sullivan

General Office: Frank Pavlik, chairman; Paul Iannello.



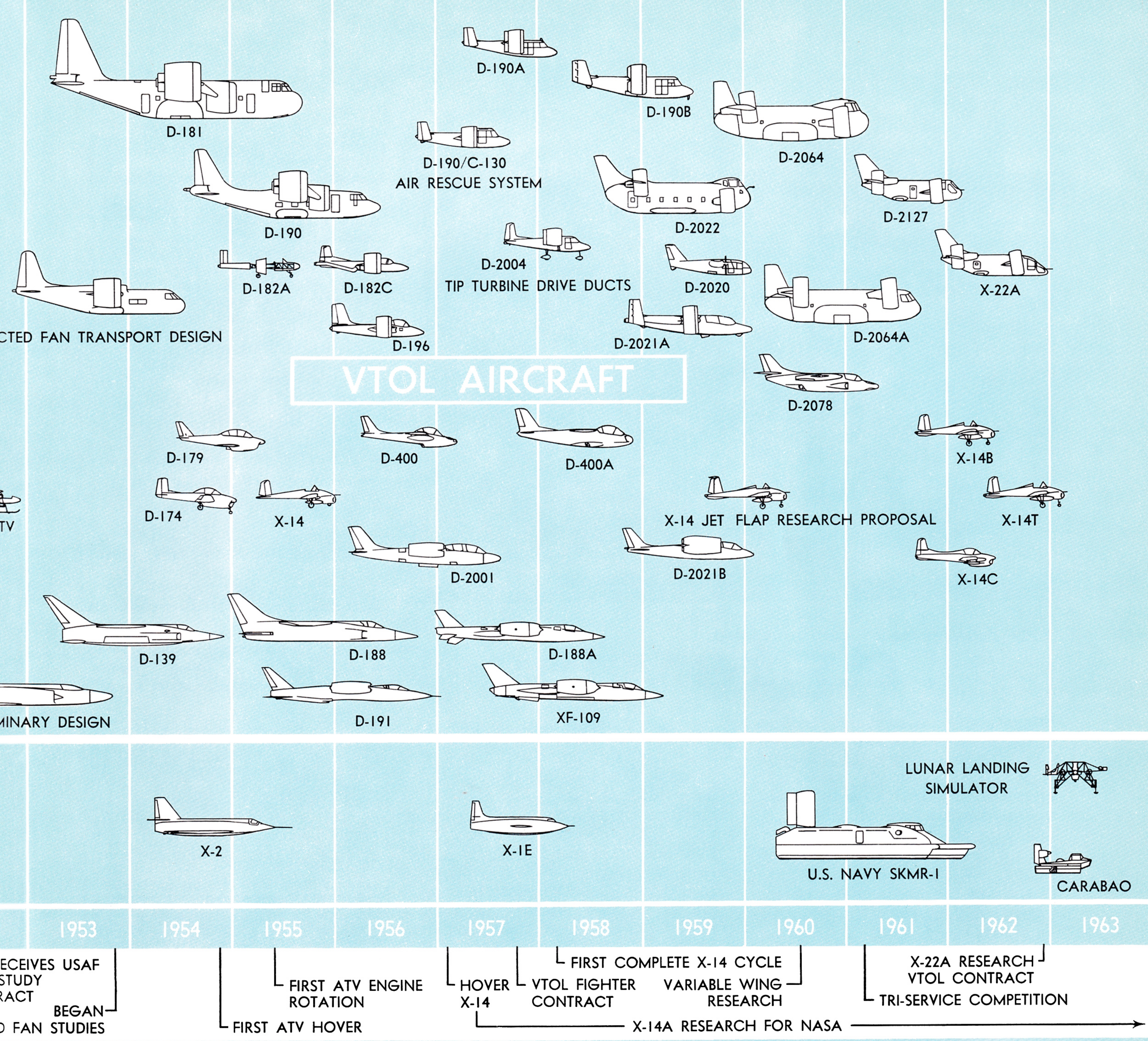
Charles Schuch, (right) foreman D-590, receives for his department a trophy from V-P William M. Smith.



John F. Dunbar, avionics material control supervisor, (left) receives a trophy from V-P John H. van Lonkhyzen.



Anthony Peters (right), manager, receives for Technical Publications a trophy from V-P Peter J. Wacks.

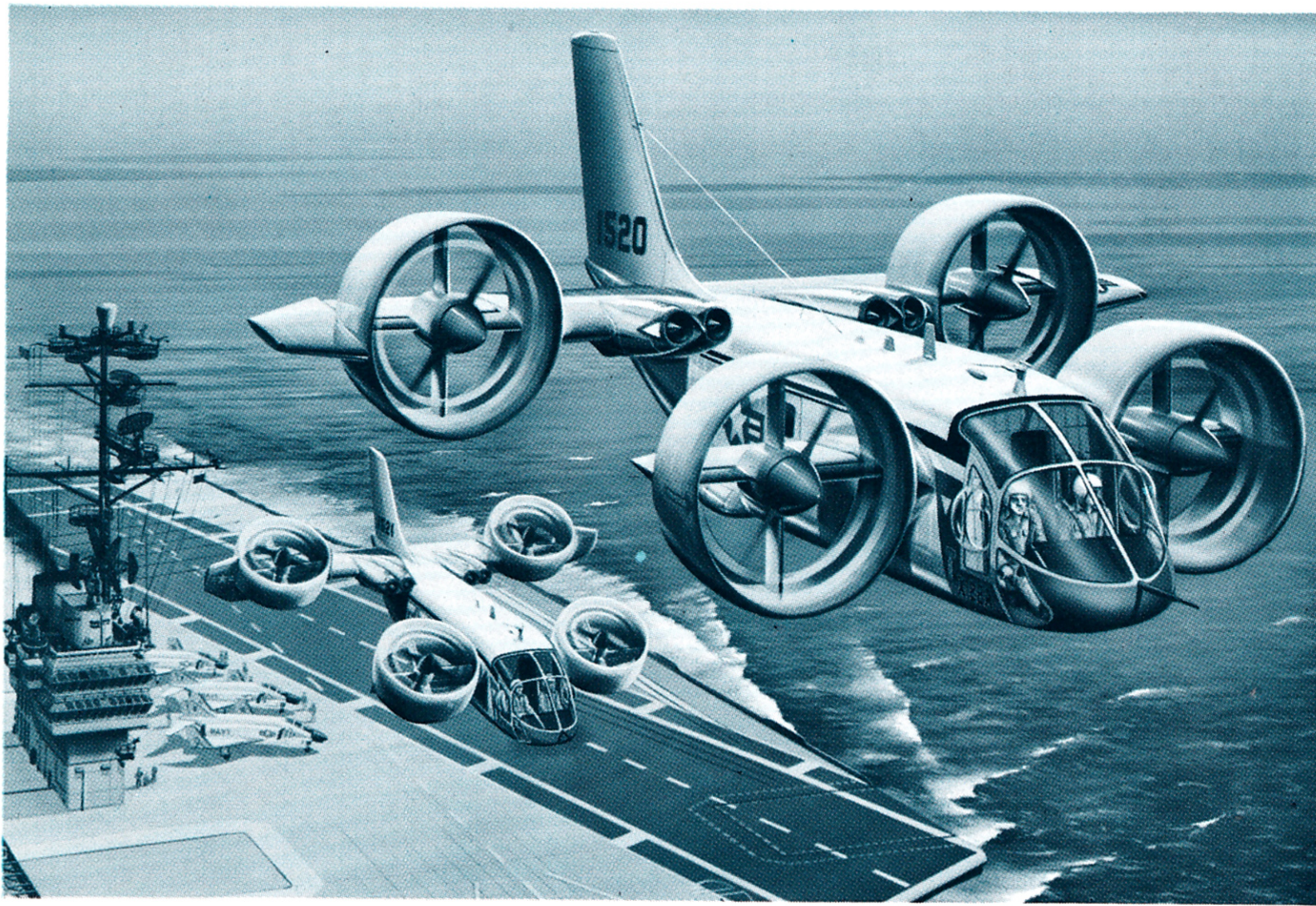


VTOL aircraft was formed by the Defense Department with an invitation to industry to contribute their ideas on the subject at a Princeton University Symposium in the fall of 1959. The Committee concluded that the state-of-the-art would support procurement of a number of V/STOL transport aircraft for the purpose of obtaining research and operational information.

These recommendations were coordinated with the military services and in 1961 a competition was held for a tri-service transport. Bell joined with Lockheed Aircraft in submitting a technical proposal. The tilt-wing concept, which had been model tested by NASA for more than ten years, was chosen as the most conservative operational concept to be explored. On the other hand, because of certain

desirable characteristics of the ducted propeller concept, the Navy requested that a smaller version of the original entries proposed by Bell and Douglas Aircraft be built and tested.

Bell won the X-22A contract Nov. 30, 1962 to cover a 42-month period. The contract calls for design, engineering, fabrication and flight test of two research VTOL aircraft with delivery scheduled for April 1966.



X-22A ducted propeller research transport.

The X-22A is sized to accomplish a broad series of research missions. Its four T-58 turboshaft engines are interconnected directly to a cross shaft driving the two rear propellers. A longitudinal shaft carries power to the forward gear box and a cross shaft connects the two forward propellers. This system provides a built-in safety feature. If three engines should fail, the fourth could drive all four propellers to keep the craft airborne.

Primary mission of the X-22A is to explore the mechanical and aerodynamic characteristics of dual tandem, ducted propeller aircraft. The ducted propeller is an ideal concept of the horizontal attitude VTOL transport airplane. The addition of the duct to the propeller results in at least a 25 percent increase in static thrust for the propeller, better stability and control during hovering and transition flight and a much more compact configuration arrangement.

The research version of the X-22A, designed to carry six passengers, will be 36 feet long and have a 40-foot wing span. The aircraft will be able to operate as a short takeoff as well as a vertical takeoff and landing transport. It will cruise at 350 mph with

a payload of 1,200 lbs. The tandem design of the propellers makes it practical for shipboard operation and below deck storage. The conservative features of design for research will permit operational versions of follow-on transports capable of carrying 20 passengers to be accomplished with a minimum of effort. A number of military missions involving transport, rescue, and logistic supply could be performed.

Development of this X-22A aircraft and the other VTOL projects currently underway should produce a revolutionary gain in commercial aircraft transports as well as in military applications.

Our projections show that the ducted propeller transport will have a competitive position in future commercial traffic in the short range intercity market. Future commercial requirements are a bit abstract. Certainly the advantages of longer range VTOL transports begin to suggest themselves as transcontinental flight time narrows to the time required to go from city centers to the airport.

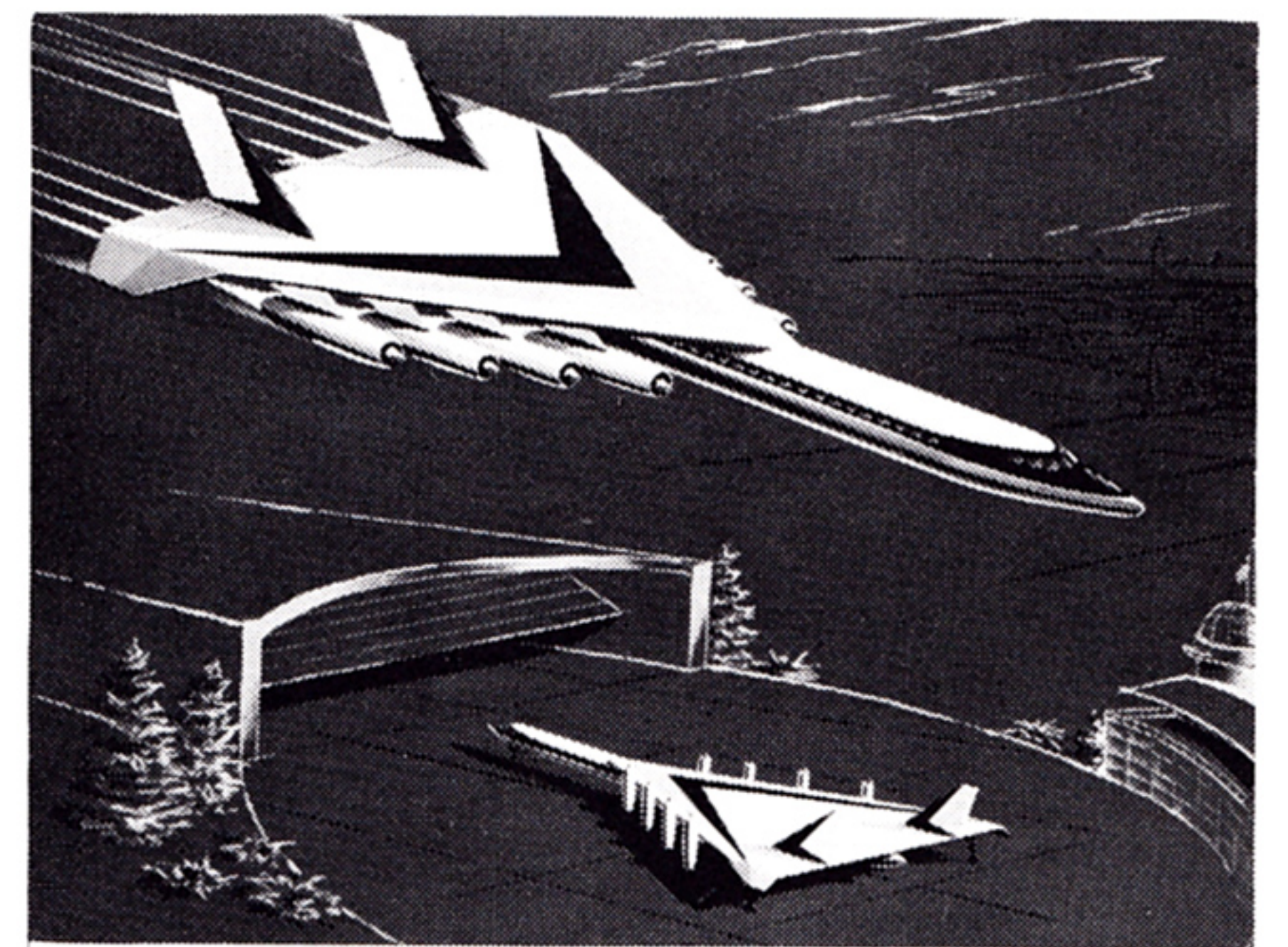
Visualizing VTOL aircraft operating between mid-town Manhattan and downtown Washington, for example,

Bell Aerosystems has signed agreements with Hughes Aircraft Company, Culver City, Calif., and Operations Research Incorporated, Silver Spring, Md., to pool the resources and capabilities of the three firms on a proposal for a planning study of an advanced V/STOL tactical fighter weapon system for the U.S. Air Force.

Although details of the system proposal are classified, William G. Gisell, Bell's President, explained the agreements combine Bell's long and varied experience in the field of V/STOL research aircraft with Hughes' outstanding record as a designer and producer of military avionics and weapon systems and Operations Research capability for studying and analyzing weapons systems planning and effectiveness.

Bell would serve as prime contractor with responsibility for the overall technical direction and definition of the depth and scope of the study.

we can certainly expect greater load factors to be stimulated on local service routes. Compared to helicopters, the increased speed potential and lower costs of V/STOL transports will permit them to operate over the longer distances required to connect these cities.

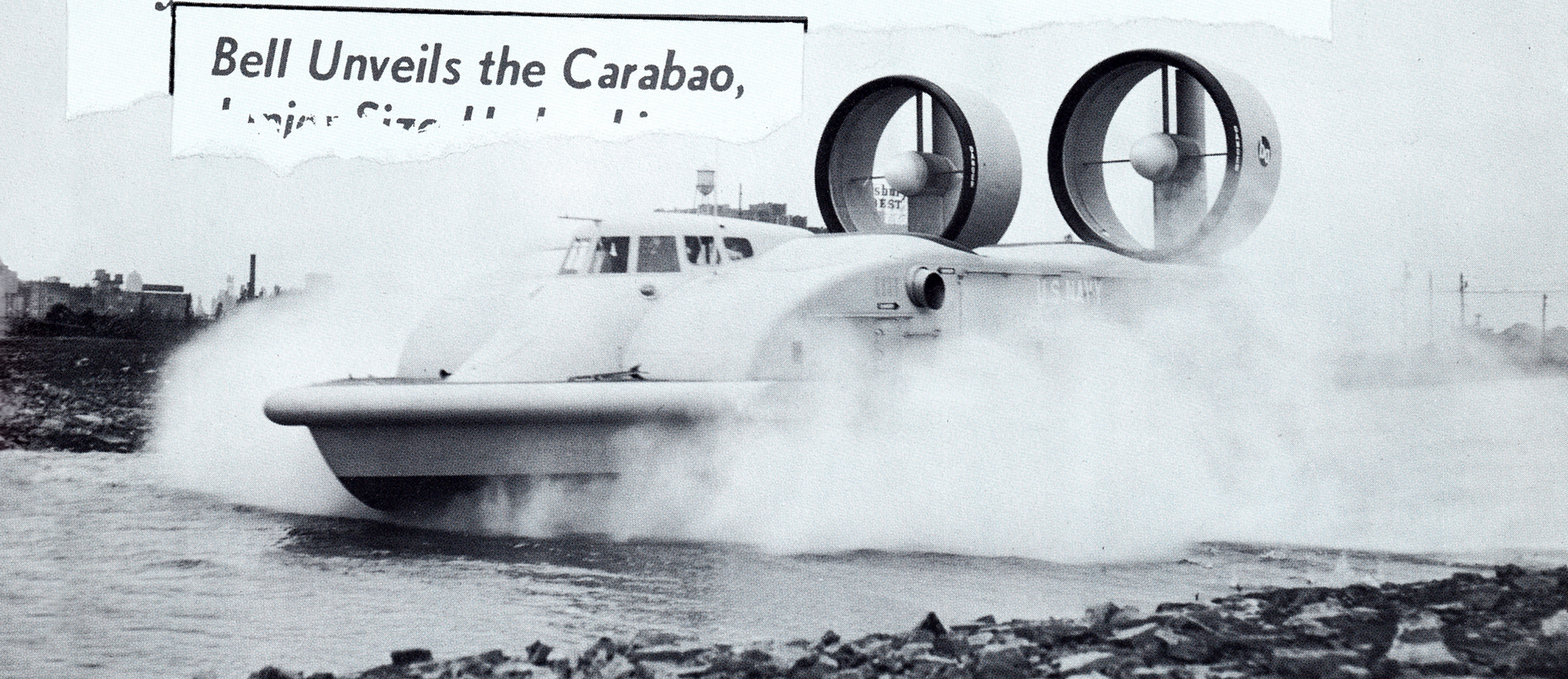


VTOL airliner of the future?

Utilization of VTOL transports in the commercial market should allow local service airlines to expand their route structures without additional expenditures for new airports. This will be a very interesting development following as it does directly from the programs currently funded by the military.

Hydroskimmer 'Great' in Water Tests

Bell Unveils the Carabao,
Major Size 11' x 11' x 11'



SKMR a-weight!

THESE major events during May, headlined by newspapers throughout the nation, highlighted more than four years of research and development of Ground Effect Machines (GEMs) by Textron's Bell Aerosystems Company.

Since 1959, when Bell engineers began working on experimental vehicles that ride on a cushion of air over a variety of surfaces, Bell has advanced the GEM state-of-the-art in the United States by designing and manufacturing two revolutionary new ground effect machines.

Largest and most spectacular of the new Bell GEMs is the 22½ ton Hydroskimmer which the company built for the U. S. Navy Bureau of Ships. Designated the SKMR-1 by the Navy, it is the largest GEM ever constructed in the United States.

The history of SKMR-1 dates back to 1959 when the Bureau of Ships launched a program aimed at development of the technology necessary to design future hydroskimmers.

To achieve this goal, the bureau constructed three test craft of small size for limited demonstration and test purposes. One of these research craft was the Bell XHS-3, an 18-foot

air cushion craft driven by an out-board motor.

However, all three early test craft were not large enough to demonstrate military capability and their small size precluded the contribution of detailed information required for the design of large ocean-going craft.

To fill this gap, BuShips then decided to begin the design and fabrication of the 22½ ton Hydroskimmer, later designated SKMR-1. A design competition conducted by BuShips during the summer of 1961 resulted in the award of the Hydroskimmer contract to Bell Aerosystems in November of that year.

A Bell engineering team, headed by Paul C. Emmons and Donald C. Wright, designed a 65-foot-long craft capable of skimming over the water on a cushion of air at speeds in excess of 70 knots. The Hydroskimmer is 27 feet wide and 23½ feet high.

Four cushion fans, mounted in the craft's hull, provide the necessary lift to raise it from the surface and enable it to hover at a height of slightly more than two feet.

Two propellers mounted in ducts on the craft's aft end supply the thrust to drive the Hydroskimmer over the

surface. Aerodynamic rudders located in the slipstream of the propellers provide directional control.

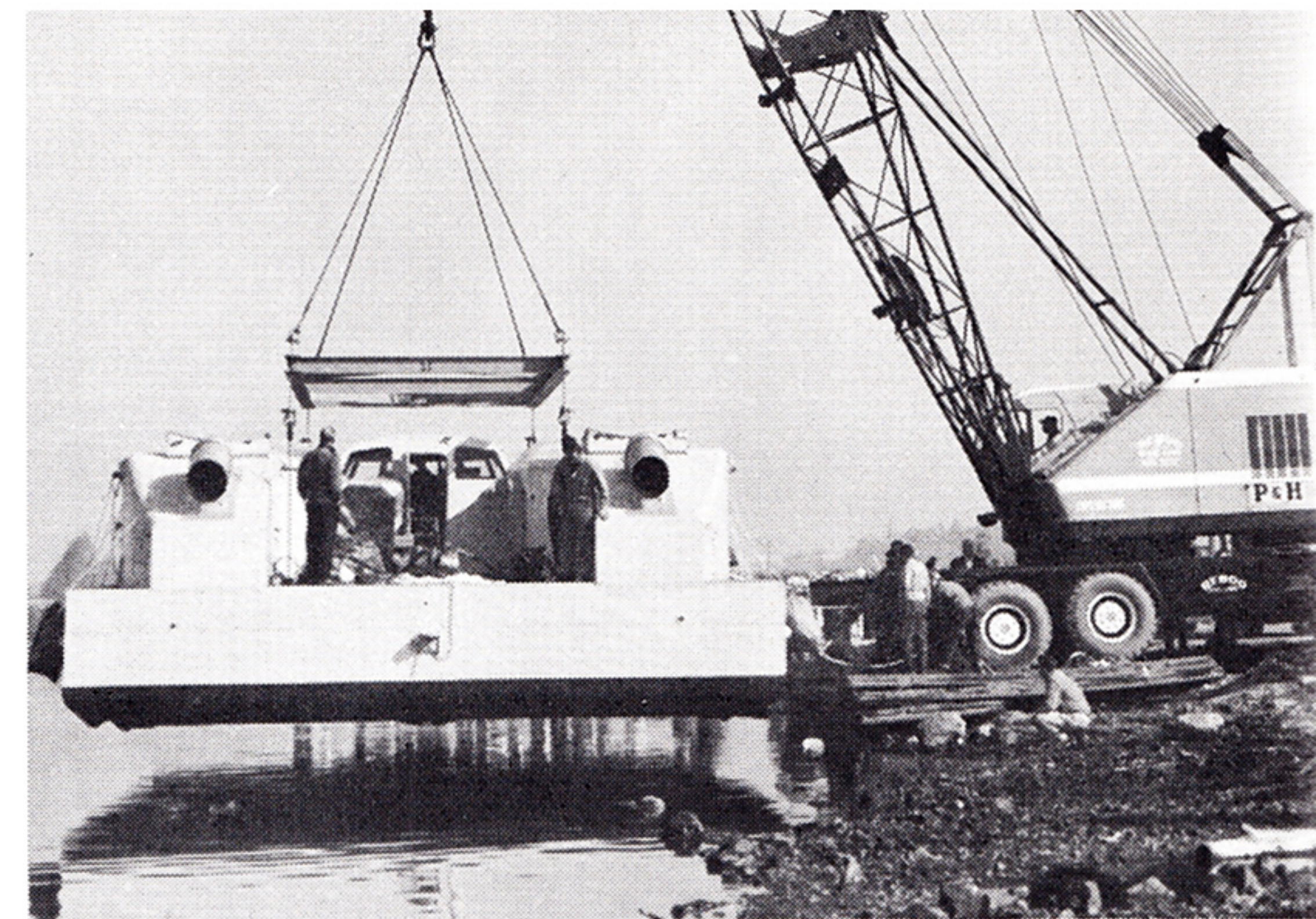
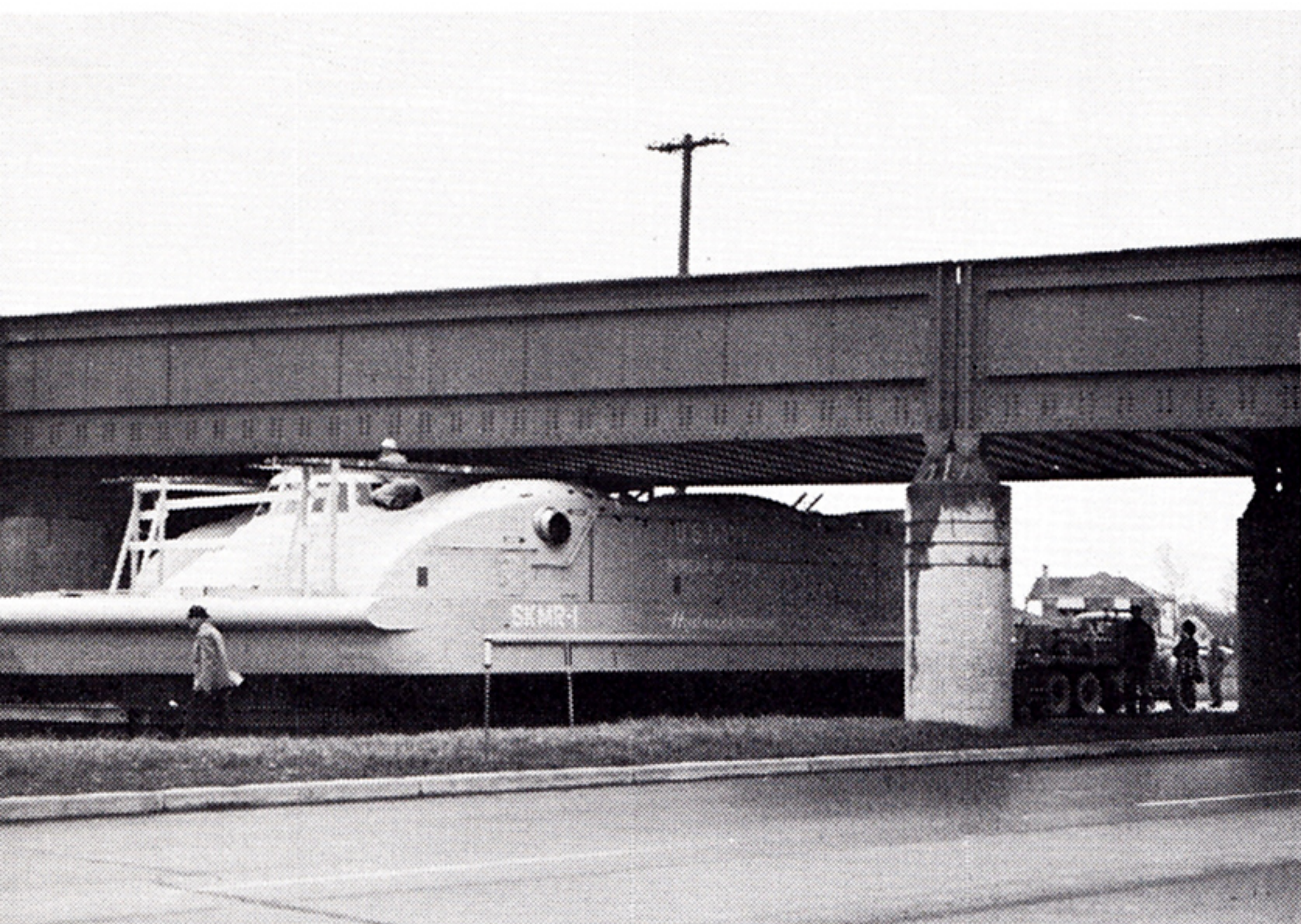
Both the cushion fans and the ducted propellers are powered by four 1080 hp marine gas turbine engines.

SKMR-1 can be controlled by either of its two operators through the use of a conventional aircraft-type dual control arrangement. As a research vehicle, accommodations are provided for only four observers in the wheelhouse. Future versions of this same size Hydroskimmer are capable of carrying up to 60 passengers.

In designing the Hydroskimmer, Bell engineers employed aircraft-type construction techniques to achieve light weight without penalizing structural integrity. For example, SKMR-1 is constructed primarily of aluminum. All elements are aluminum except the superstructure and wheelhouse, which are made of fiber glass, and the deck which is balsa wood faced with aluminum.

SKMR-1 rolled off the production line at the Bell Wheatfield plant on April 26—the date agreed upon by Bell management and the U.S. Navy Bureau of Ships 1½ years earlier.

After passing preliminary ground



It's a narrow squeeze-through as SKMR-1 begins its trip to river at river's edge, she's lowered in

tests on the Bell ramp at Niagara Falls Municipal Airport during the first two weeks of May, SKMR-1 was declared ready for its first water trials.

The huge ground effect machine was transferred from the Wheatfield plant to Bell's new Hydroskimmer Test Base on Lake Erie at Buffalo in a 28½ mile move that required close coordination between the company, three subcontractors, municipalities, law enforcement agencies, utility companies and the railroads.

Riding on a specially-built 48-wheel drop-bed trailer built by Roetzer Engineering Company of Buffalo, SKMR-1 was towed from the Wheatfield plant on the morning of May 20. The craft's ducted propellers were removed so it could slip under railroad overpass, power lines and overhead traffic signals along the route.

Traveling at a snail's pace of less than one mile per hour, the Hydroskimmer covered the 4½ miles from plant to launch site in about seven hours. SKMR-1 remained under guard overnight at the launch site on the Niagara River bank near River and Witmer Roads in North Tonawanda.

Word of the SKMR-1 move spread rapidly as all area newspapers and radio and television stations carried reports. Police estimated that 5,000 residents of the Niagara Frontier visited the launch site Monday afternoon and evening to get their first glimpse of the nation's largest GEM.

The following morning Rebco Steel Corporation's 80-ton crane, one of the largest in the area, was used to hoist SKMR-1 from the trailer and ease it into the water for the first time.

Tamco Marine Inc. of Buffalo was responsible for moving the Hydroskimmer over the 24 miles of waterways from the North Tonawanda

launch site to the test base on the Buffalo waterfront.

Lines were tied onto SKMR-1 and a cabin cruiser named "Rendezvous" was used as a tugboat to tow the Hydroskimmer in the Niagara River and through the Black Rock Canal to the test base. The ducted propellers were mounted in place again and the craft was all set for its first water trials.

SKMR-1 was rolled out of its hangar on the morning of May 27. A brief series of engine runups and ground tests preceded its "maiden voyage" in Buffalo Harbor. At the controls were A. G. (Slim) Russell, Bell's director of flight research, and David W. Howe, veteran test pilot.

The 22½-ton Hydroskimmer lifted off the concrete apron in front of the hangar and headed down the ramp toward the water. It splashed into the water and then lifted again to a height of about two feet above the surface of the lake.

Operating between the shore and the breakwall, SKMR-1 headed toward the harbor entrance, maneuvered a tight turn and then made its first speed run. The dramatic trail of spray churned up by the unique craft left no doubt that SKMR-1 was the fastest vessel ever operated in Buffalo Harbor. Several more speed runs and maneuverability tests were made that particular day.

"This was as fine a first flight as you could have," Russell commented to reporters after the water trials. "It was just great!"

Russell said SKMR-1 achieved all of its design parameters during the trials and had power to spare when it reached a speed of 40 knots — the maximum permitted for the craft in the inner harbor.

The preliminary over-water tests in-

dicated the need for a modification of the four cushion fans which provide the lift for the huge air cushion craft. This work is now under way.

When the modifications are completed, an extensive test program for the huge research craft will commence. Purpose of the test program is to accumulate research information on the operating characteristics of the Hydroskimmer to formulate design criteria for larger ocean-going craft. The tests on Lake Erie will include operation in rough water, handling and maneuvering trials and speed runs.

The Navy said the design and successful research program of SKMR-1 eventually is expected to lead to a Hydroskimmer-type craft as long as a destroyer, but with twice its width and capable of twice a destroyer's speed and range.

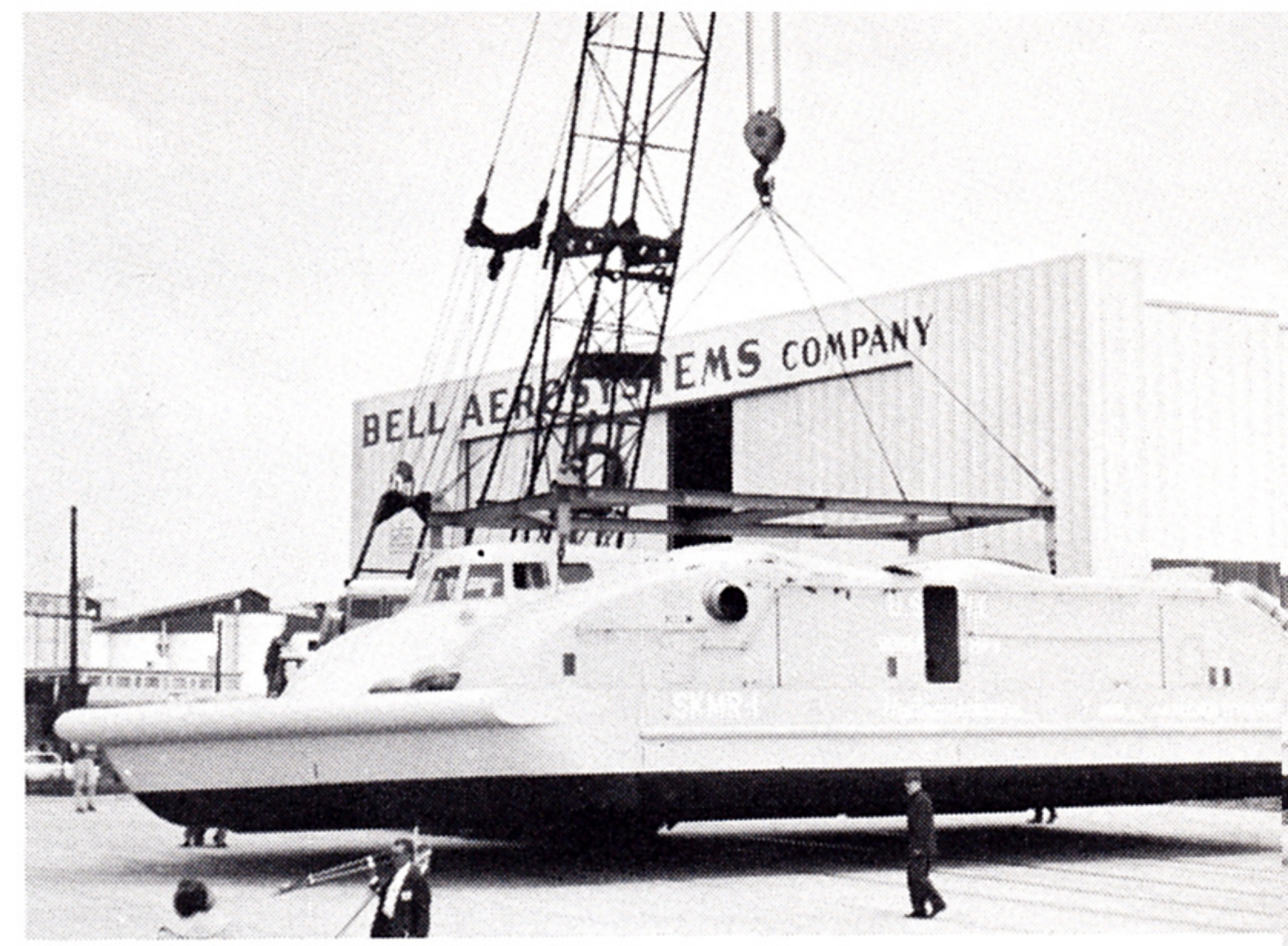
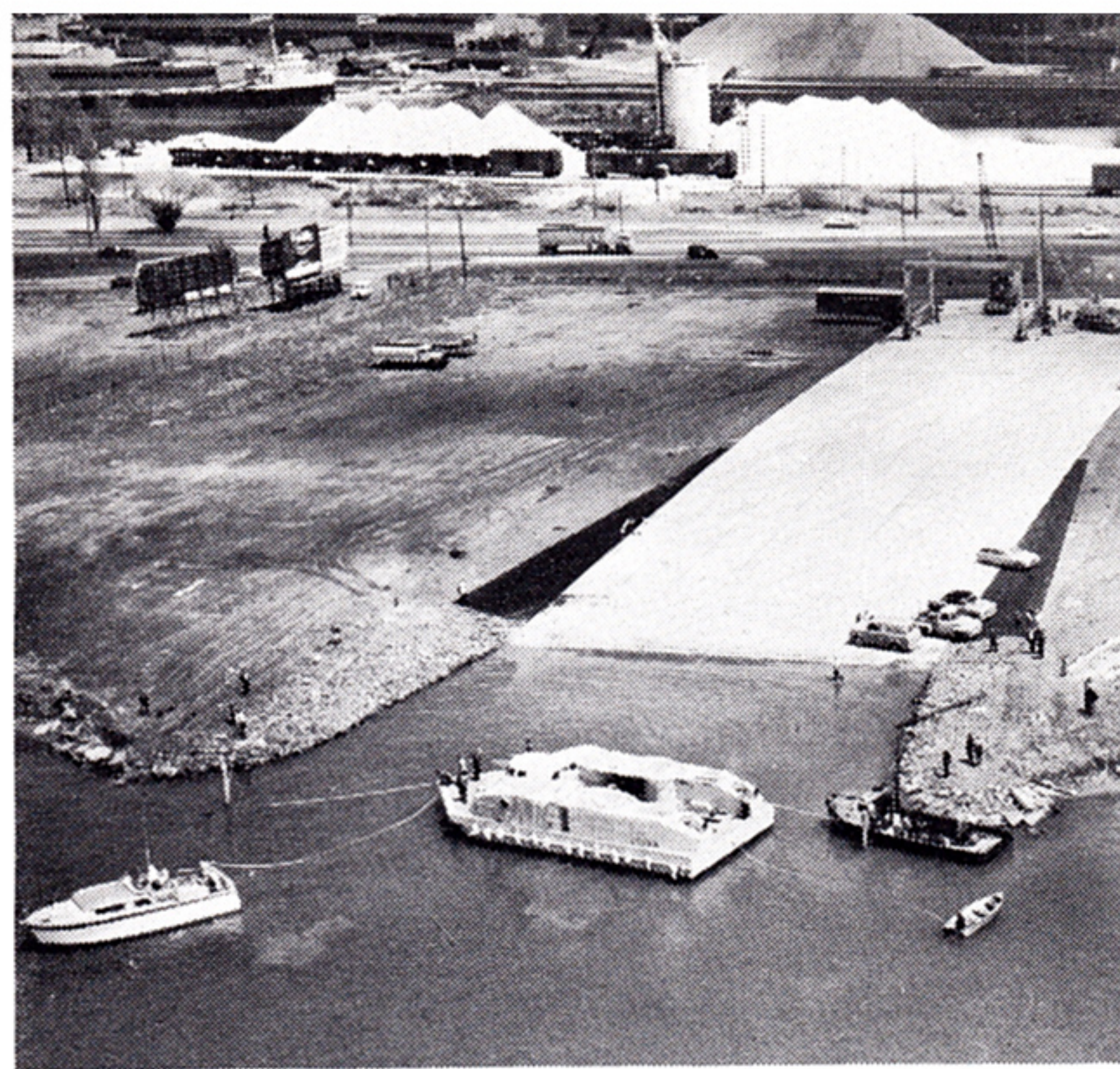
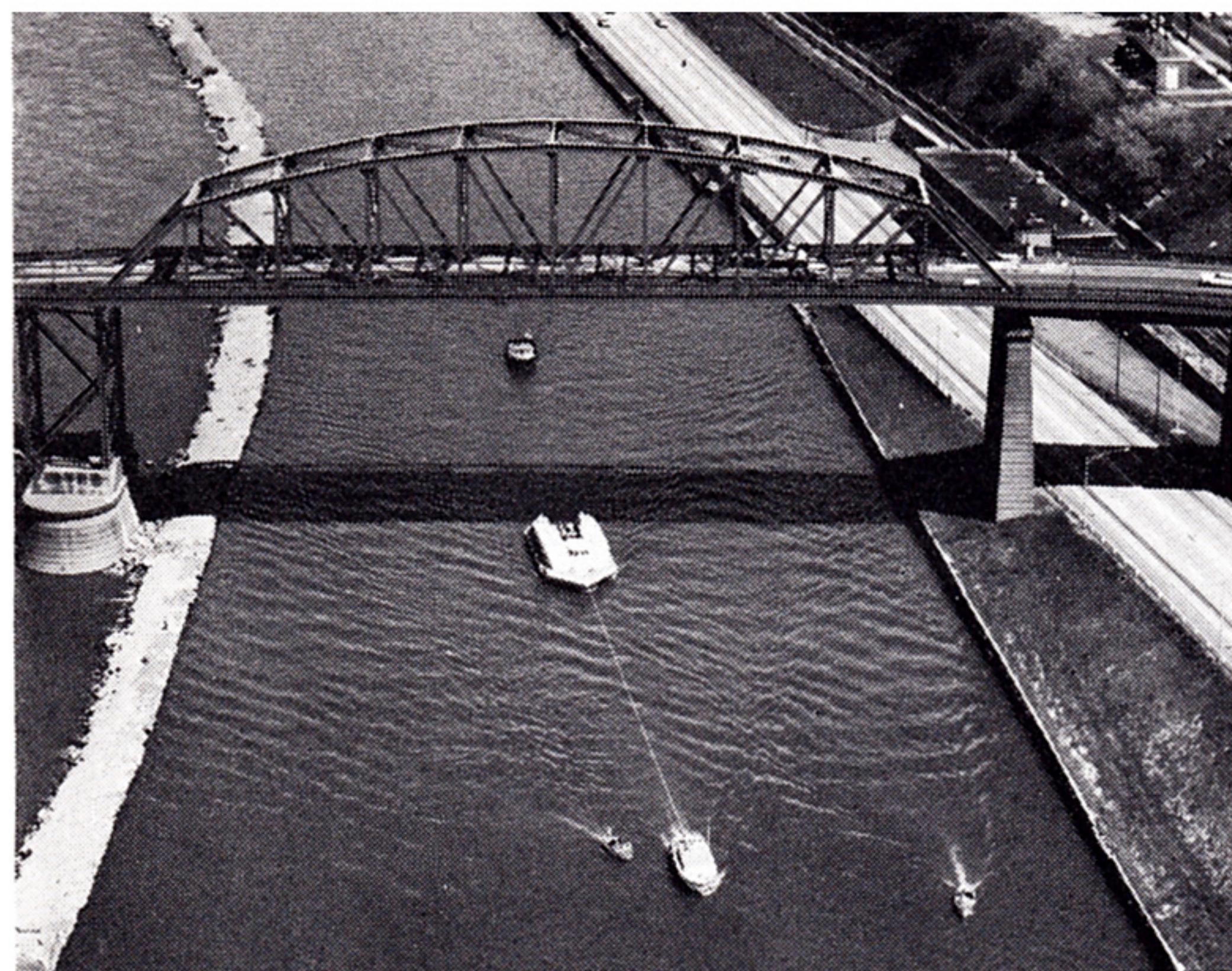
Among the military missions considered for Hydroskimmer-type craft are anti-submarine warfare, landing and patrol operations, mine countermeasures, high-speed transport of men and cargo, and rescue operations.

Meanwhile as fabrication of the Hydroskimmer progressed, Bell GEM engineer John B. Chaplin advanced a new concept in the design of ground effect machines.

Chaplin, a research engineer with extensive experience in the design, development and testing of GEMs in England before he joined Bell in 1962, proposed the unique tri-cell concept of building the GEM around three circular cells to provide greater stability.

Bell Aerosystems funded the tri-cell program, and Chaplin headed a team of engineers who designed a rugged and versatile GEM which was capable of a variety of missions in normally inaccessible areas.

The new GEM, much smaller than



towed down river 'neath Peace Bridge journey's end safe at home after baptism

the Hydroskimmer, was named the "Carabao" after the tough and versatile water buffalo of the Philippines. The name is appropriate because both the animal and the vehicle are able to perform difficult tasks in water, marsh and on land.

The "Carabao" was unveiled to military, industrial and governmental representatives and to the press at the Buffalo waterfront test base on May 2. Lake Erie was still clogged with ice floes, some as large as three feet thick, as the "Carabao" demonstrated its multi-surface capabilities.

With Chief Test Pilot Albert W. Courtial in the driver's seat, the "Carabao" lifted off the ramp as its three circular cells filled with air. It headed down the concrete ramp and into the lake, skimmed over ice floes up to two feet high and achieved speeds in excess of 60 miles per hour.

A single lift fan feeds the three circular cells which are equally spaced around the center of the vehicle. An aft-mounted variable pitch propeller is used for propulsion and braking.

It is an extremely maneuverable machine, and a high degree of control is provided by twin rudders in the slipstream of the propellers. This is augmented by differential braking of two side wheels when operated over land.

The "Carabao" is 18.7 feet long, 16 feet wide and has an overall height of 10 feet. The side extensions of the vehicle fold upward and reduce its width to 9.7 feet to enable it to be towed along roads to emergencies.

Normal operating weight of the vehicle is 2,900 pounds. An additional 1,000 pounds payload can be carried with consequent reduction in performance.

The vehicle has a two-place cabin, but requires only one operator. The control system is designed to permit operation with little more training than normally required for a car.

The new machine has the load-carrying and mobility features of a truck and a boat. But the "Carabao", a truly amphibious vehicle, has an advantage over both of these standard modes of transportation because it

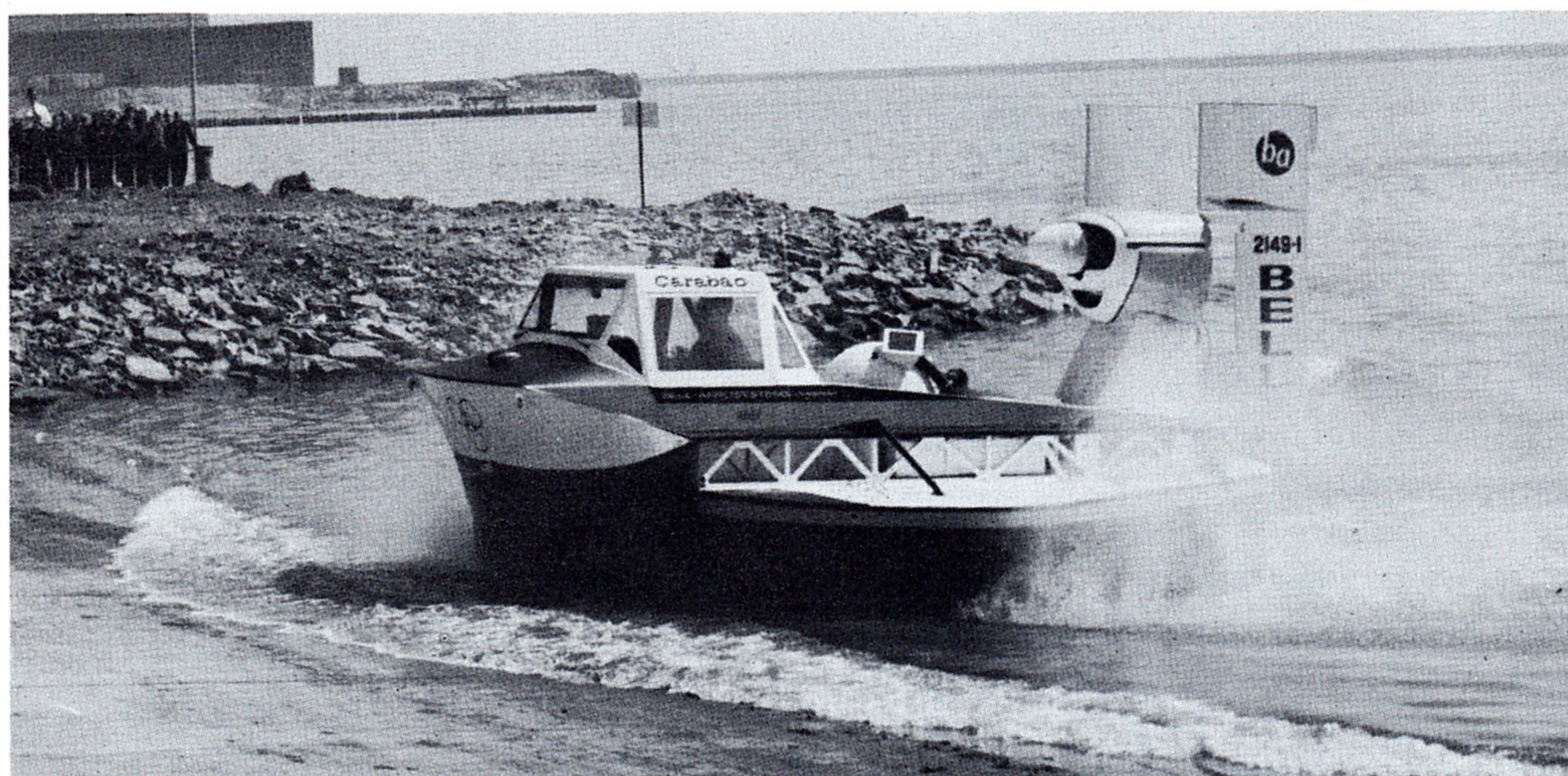
rides on a cushion of air. For this reason, it also can traverse mud, marsh and ice as well as land and water.

Oil companies have expressed interest in the "Carabao" as a utility vehicle to support off-shore oil drilling operations, and the machine's capability for this application is scheduled to be demonstrated during a tour of Gulf Coast states this summer.

At the same time, use of the "Carabao" as a means of spraying insecticides and weed-killing chemicals in swamps, marshes and irrigation canals also will be shown to representatives of the U.S. Army Corps of Engineers and several southeastern states.

Other proposed assignments the "Carabao" is capable of handling include harbor and river patrols, performing rescues in flooded areas, and airport emergency operations.

With the huge Hydroskimmer and the tiny "Carabao," Bell Aerosystems has developed two versatile entries for transportation's newest field.

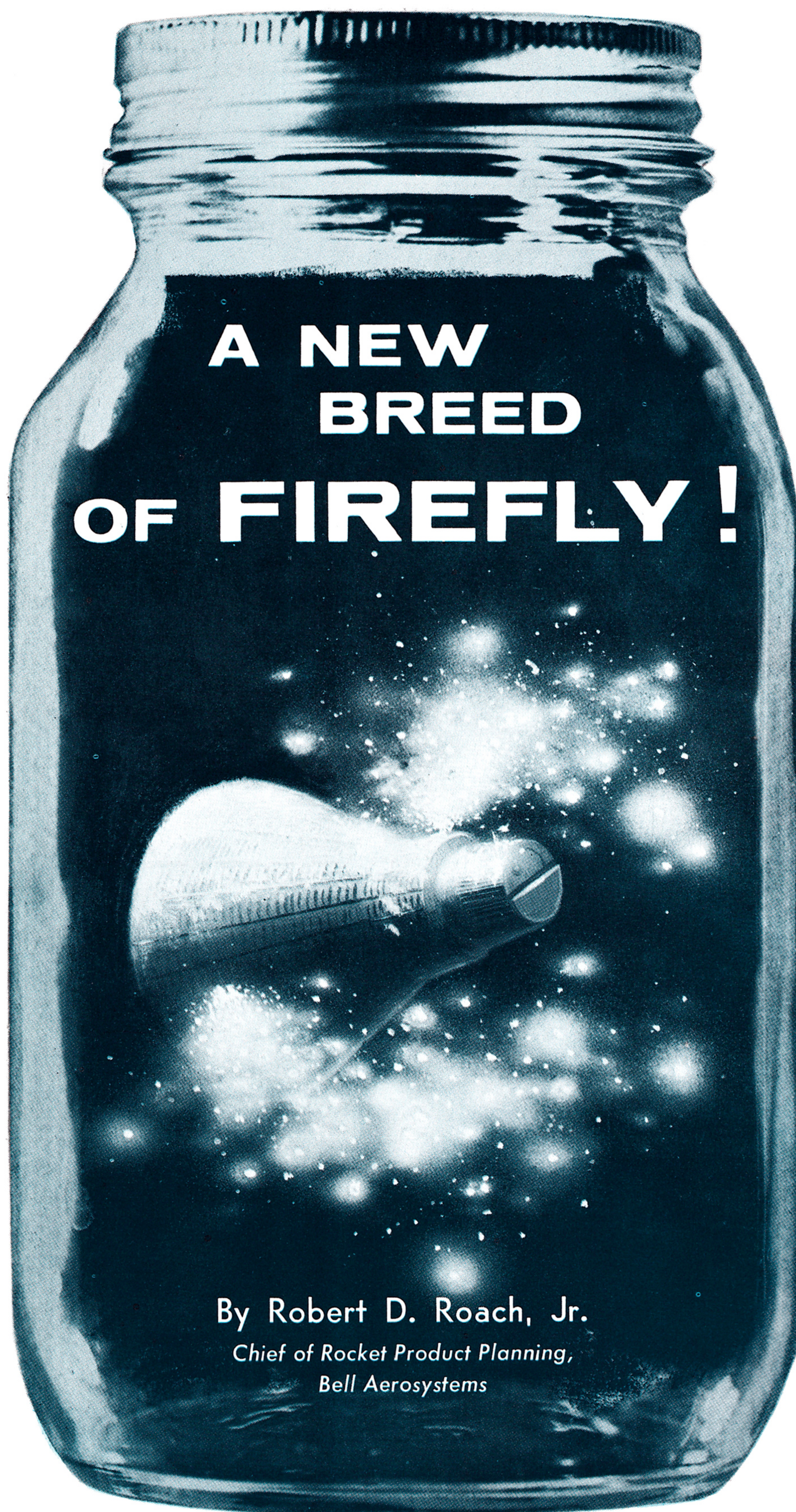


Bell's Carabao skims up harbor test ramp.

Bell Aerosystems has signed a licensing agreement with Hovercraft Development Ltd., of London, England, and Westland S.A., of Geneva, Switzerland, a subsidiary of Westland Aircraft Ltd., Yeovil, England, which gives Bell U.S. rights to manufacture and sell air cushion vehicles embodying the patented inventions held by the European companies.

In addition Bell obtains exclusive U.S. rights to Westland patents.

In essence, the agreement forms an international team of companies active in this new field who will be able to pool their design and technical experience to develop the full potential of this new means of transportation.



WHO can forget his first experience on a summer night collecting lightning bugs or fireflies in one of Mom's old glass canning jars? If you could catch enough of them in one jar, you had a flashing lantern as the little insects ignited their tiny tail cones.

Now a new breed of firefly has been found illuminating the cold, dark vacuum of outer space.

The space age with its new environments and experiences for man, permits the scientist to hypothesize as to the nature of many newly observed phenomena. New concern surrounds heretofore accepted theory (e.g., the character of the lunar surface: solid?; dust?; how thick is the dust layer?)

One particularly interesting phenomenon first reported by John Glenn on his historic orbital spaceflight was that of the "fireflies" which appeared on each orbit at sunrise. Confirming the appearance of these luminous particles, Scott Carpenter, the second orbital Astronaut, provided further information by his ability to tap on the inside wall of the spacecraft and cause the yellow-green particles to flake off from the outside of the spacecraft. Next, Wally Schirra reported the occurrence of the yellow-green particles at the sunrise portion of the orbit.

On his recent flight, Astronaut Gordon Cooper observed the flow of "fireflies" from the spacecraft's reaction control rockets. He reported seeing great streams of them coming from the thrusters and drifting away while some attached themselves to the spacecraft only to come off later. John Glenn had at one point in his flight observed the discharge of gases from one of the thrusters — without detecting any "fireflies". He said one of his first thoughts was to attribute these luminous particles to water droplets condensing out of the steam from the reaction control rockets. His observation may have been made when the sun had risen to a point where the background did not provide sufficient contrast to observe the luminous particles. Cooper's observations were made on the night side of the orbits.

With Cooper's very positive identification of the origin of the "fireflies," we may now attempt to explain their nature and outward appearance, as witnessed by each of the orbital Astronauts.

The working fluid used for these

small reaction control rockets or thrusters as they are called, is hydrogen peroxide. In passing over a series of silver screens (catalyst bed), this chemical decomposes into steam and oxygen. Certainly, traces of other elements will enter the exhaust gases. The decomposition temperature of approximately 1300°F may give special properties to these gases.

From these available known chemical and physical data, several possible explanations of the "fireflies" are suggested.

Since a large portion (54%) of the exhaust products is steam, there can be rapid condensation to water and subsequent freezing into ice particles or snow flakes, due to the extreme low temperature of matter while orbiting in the earth's shadow.

Light from the sun may be either reflected from the particle surfaces, or transmitted through them if their nature permits. The sunlight, is known to contain a visible green wavelength (5577 angstrom units) known as "green flash". This "green flash" has been observed and recorded from the earth usually during sunsets. Research rocket probes have located this same wave length of light at altitudes up to 100 kilometers above the earth. The "green flash" is believed to result from the release of a finite part of the energy acquired by highly ionized atoms of oxygen when they collide with particles hurled into space from the sun.

Thus, a source of yellow-green light does exist at Mercury spacecraft orbital altitudes, and this light could be reflected from the snowflakes or frozen steam condensate.

Another theory was advanced after Scott Carpenter's wall tapping caused apparent breakaway of "fireflies" from the outside of the spacecraft.

The belief was that small particles of paint from the outer surface of the spacecraft were flaking off and reflecting the yellow-green light. Astronaut Cooper's observations, however, would explain the detachment of "fireflies" from the spacecraft. He observed that as the luminous particles came by the spacecraft some attached themselves to its outer surface. This occurrence lends support to the theory that the particles are frozen water or snowflakes. Their attachment to the spacecraft may be explained as follows:

1. The snowflakes impact upon the spacecraft outer surface.

2. The kinetic energy possessed by the particle while in motion is converted to other forms of energy at the time of particle impact. One of these forms is heat.

3. The heat causes partial melting of the snowflake, and the extremely cold spacecraft wall causes it to immediately re-freeze and attach to that surface.

4. Vibration or temperature change of the spacecraft wall causes the frozen particles to detach.

"... I found that on the night side when you were maneuvering you see each thruster fire and these "fireflies" were coming out in great quantities from each thruster as you would fire. They were bright, and they had a faint, very, very faint greenish tint to them. Some of them apparently were hanging onto the spacecraft and would come off at other times. But great streams of them would come right out of the thrusters and drift away. From this I think it's pretty conclusive that these are coming from our own little peroxide thrusters."

**Astronaut L. Gordon Cooper
May 19, 1963**

Another totally different theory may also be advanced for the "firefly" phenomenon.

First we may assume that some of the oxygen, which is in the gas stream coming from the reaction control rockets, is ionized. As these ions move through space they collide with the previously mentioned particles of matter which originated in the sun. A high rate of collisions would cause the apparent continuous evolution of the green light.

Colonel Glenn suggested that these "fireflies" might be ionized because they were attracted to the spacecraft. This factor then lends support to the oxygen ion theory.

The "firefly" phenomenon or Glenn effect, has been clearly established as a spacecraft-generated spectacle. There is no extra-terrestrial source for the observed luminous particles. For this reason, there is no serious concern over the true nature of these particles or the source of their particular color. Two

theories have been discussed. The one, the snowflake theory, seems most probable; while the other, the oxygen ion theory, is certainly possible but much less probable.

The "fireflies", although harmless to present spacecraft and the associated experiments, might be undesirable in future experiments. On the other hand, the "fireflies" could prove beneficial to space experimentation. To the scientist, the "firefly" phenomenon explained in terms of the snowflake theory, is at once both a logically defined occurrence and an event which contradicts classic belief as to behavior of gases and liquids in a near perfect vacuum. We know that steam condenses to water, and we know that this water will freeze in the space environment; but, at the same time we cannot help but wonder why the dispersal of the gases and liquids in a vacuum does not occur so rapidly as to preclude snowflake formation.

A definite resolution of the "firefly" phenomenon can be expected as a result of future space flights using hydrogen peroxide reaction controls. Although the Mercury program is completed, others such as the X-20 Dyna-Soar project will provide additional information on the "fireflies." Conceivably, samples of the luminous particles could be collected during the course of a spaceflight, and their identity established through laboratory analysis. This analysis could be conducted either in a manned space laboratory or the samples might be returned to earthbound laboratories. The orbital space lab offers the advantage of utilizing the space environments of vacuum, temperature and radiation to carry out experimentation under the actual conditions that prevail during occurrence of the phenomenon.

A few more observations and perhaps the luxury of collecting an actual "firefly" sample will bring an accepted definition to the theory of their occurrence.

Man's conquest of space will not come without many previously unobserved phenomena being witnessed and experienced by the pioneering space travellers. Many of the new phenomena will be more profound, but the "fireflies" will always be remembered as man's first unique encounter with the unknown wonders of space.

PATENTS

Patents awarded by the U.S. Patent Office to Bell employees during 1962 included the following:

AIRCRAFT TAKE-OFF ASSIST DEVICE — *To facilitate takeoff of jet VTOL by eliminating the deleterious effects of jet impingement. Invented by A. M. Jackes. Issued Jan. 9, 1962.*

PROPULSION UNIT — *Controllable rocket propulsion device (Rocket Belt). Invented by Wendell F. Moore. Issued Feb. 13, 1962.*

AIRCRAFT — *Ornamental design of D-188 VTOL fighter-bomber. Invented by E. P. Knauer, E. W. Stevens and M. Zurawinski. Issued Mar. 20, 1962.*

CIRCULAR WELDING DEVICE — *Welding machine adapter to weld foil-thickness metals in continuous manner along controlled, generally circular path. Invented by Robert L. Brown. Issued April 10, 1962.*

METHOD OF USING OXALIC ACID AS COOLING AGENT — *Method to use it as cooling agent or for gas generating particularly in rocket-powered missiles. Invented by W. A. Bergdorf and E. A. Saltarelli. Issued April 17, 1962.*

PULSE SIGNAL PROPORTIONAL CONTROL SERVOSYSTEM — *Remote system in which control information is contained in width or duration of pulses of energy transmitted at a constant repetitive rate in which possible control functions include continuous rotation of a shaft through any number of degrees in either direction. Invented by C. E. Hills. Issued April 24, 1962.*

PUMP SEAL — *Combination static-dynamic shaft seal for high speed pumps or turbines preventing leakage by contact seal at idle or low speed conditions in combination with liquid sealing means during high speed operation. Invented by D. E. Singelmann. Issued Aug. 14, 1962.*

INSULATION — *Method of manufacturing heat insulating package to form-sustaining prescribed shape suitable for re-entry vehicles. Invented by G. Strasser. Issued Sept. 4, 1962.*

HYDROSTATIC BEARING SYSTEM — *Segmented system eliminating high alignment accuracies usually required as well as tolerating extreme temperature changes. Invented by J. C. Trotter. Issued Sept. 4, 1962.*

AIRCRAFT PILOT INSTRUMENT — *Instrument to indicate thermal condition of aircraft and how long craft may safely continue to operate under such condition in view of thermal effect on aircraft structure as well as indication as to what extent operational life of aircraft has been expended by cumulative effects of high temperatures to which aircraft has been exposed during missions. Invented by R. Goldin. Issued Sept. 4, 1962.*

MARINE PROPULSION — *For hydrofoil craft utilizing jet engine combined with propelling pump enclosed within foil or supporting strut thus eliminating heavy gear boxes. Invented by D. E. Singelmann. Issued Sept. 25, 1962.*

JET PROPELLED AQUATIC VEHICLE — *Propulsion utilizing high capacity fluid pump and jet engine in conjunction with novel ducting system for propelling boat or amphibious vehicles. Invented by D. E. Singelmann. Issued July 3, 1962.*

REGULATOR SYSTEM FOR CONTROLLING FLOW OF TWO INDEPENDENT FLUIDS — *Improved system capable of controlling flow of two fluids in response to single command in compact package. Invented by R. C. Nesselbush and C. J. Turansky. Issued Oct. 16, 1962.*

AUTOMATIC CONTROL APPARATUS — *Control method for maneuvering of ducted fan VTOL aircraft throughout all flight regimes. Invented by C. M. Sperazz and M. Zurawinski. Issued Oct. 30, 1962.*

HYDROSTATIC BEARING — *Combination of low cost ball or roller bearings with high anti-friction capabilities of hydrostatic bearing. Invented by J. C. Trotter. Issued Nov. 20, 1962.*

SPACE BELT — *Device to propel man or object in space under zero gravity conditions. Invented by Wendell F. Moore. Issued Dec. 4, 1962.*

TRANSFER POWER AMPLIFIER — *Nearly doubles available driving power for a given magnitude. Invented by C. A. Hultberg. Issued Dec. 11, 1962.*

MECHANICAL DEVICE — *Mechanical drive connection allowing certain degree of misalignment and wide speed charging range without resorting to conventional gear trains. Invented by D. E. Singelmann. Issued Dec. 18, 1962.*

REACTION MOTOR THRUST CONTROL VALVE — *Control valve to regulate thrust of reaction motor capable of withstanding both extremely high pressures and temperatures. Invented by Wendell F. Moore. Issued Dec. 25, 1962.*



'OOH LA LA', C'EST MAGNIFIQUE!

World aviation enthusiasts attending the recent International Aviation and Space Exposition in Paris reacted very much as people do here at home when they see the Bell Rocket Belt demonstrated. They hailed it as a highlight of the show.

"Paris Match," one of Paris' leading magazines, called Peter L. Kedzierski and Robert F. Courter, Jr., Bell's Rocket Belt operators, "the bird men." Between them they flew before more than a million persons in the nine days of the exposition. Their appearance was sponsored by the U.S. Army Mobility Command.

Commenting on the demonstrations, a representative of the Army command said they "made a significant contribution to the enhancement of the technical prestige of the United States."

Here Kedzierski flies over the hemispheric pavilion

housing the National Aeronautics and Space Administration's space display. During the Paris show, the Rocket Belt was flown twice daily.

Following Paris, the Rocket Belt Demonstration Team flew back to the U.S. to perform at the Fifth Annual Chicago International Trade Fair. Before summer's end, they will have flown at Teenage Fairs in New York City and Boston, and at the famous Calgary Stampede in Alberta, Canada. Early in August they fly down to Rio de Janeiro, Brazil, under contract to the U.S. Department of Commerce, to perform as a part of the U.S. exhibit at Rio's International Trade Fair.

The world's first personal propulsion system, invented and developed by Bell, is coming into its own. Having proved the feasibility of individual rocket flight, only yesterday the province of visionaries and cartoonists, the Rocket Belt stirs the imagination as to its future prospects.



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